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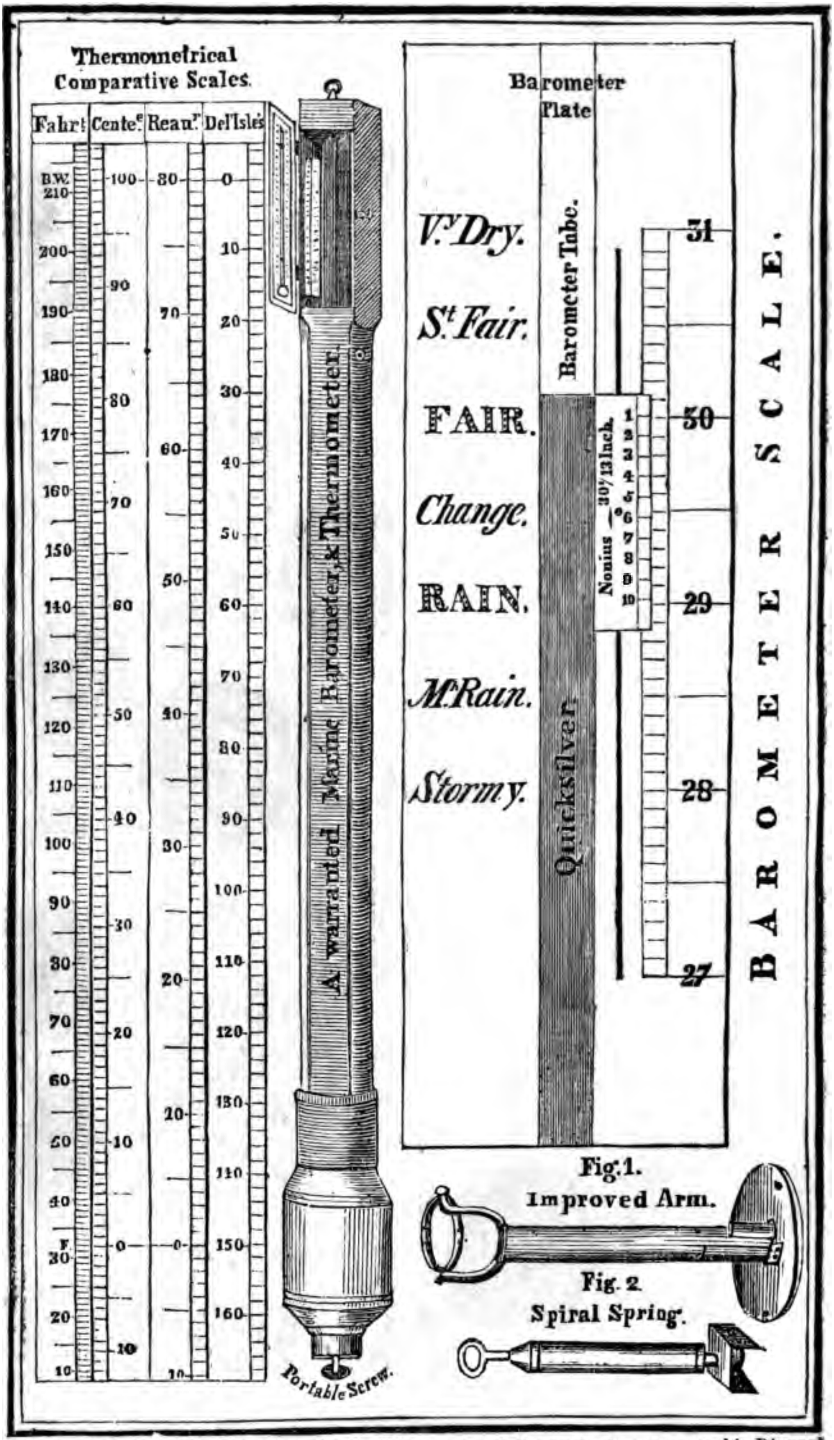

Engraved for Dennis's Directions for the Thermometer & Barometer to accompany his Diurnal ***Register.***

AMPLE INSTRUCTIONS

FOR THE

BAROMETER AND THERMOMETER;

CONTAINING

PARTICULAR DIRECTIONS FOR THE

MARINE AND HOUSE BAROMETERS,

OR

WEATHER GLASSES;

THE INSTRUCTIONS ARE ALSO APPLICABLE TO THE

SYMPIESOMETER AND OIL BAROMETER;

WITH

RULES TO BE OBSERVED IN USING

THE STORM GLASS;

INCLUDING

TABLES OF THE TEMPERATURE OF THE SEA,

FROM MR. ABEL CLARKE, &c.

AND REMARKS MADE BY CAPTAINS SABINE AND HALL, R. N.; LIEUT. WHITE, U. S. N.;
COLONEL WILLIAMS, U. S. A.; AND CAPT. KRUSENSTERN, RUSSIAN NAVY.

TO WHICH IS ADDED,

A PERPETUAL WEATHER TABLE, VARIOUS ATMOSPHERICAL PHENOMENA, &c.

NEW YORK;
PUBLISHED BY G. LEONI,
IMPORTER AND MANUFACTURER OF MATHEMATICAL AND
PHILOSOPHICAL INSTRUMENTS, &c.
No. 102 John Street.

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INSTRUCTIONS AND OBSERVATIONS

RELATIVE TO

BAROMETERS AND THERMOMETERS.

The Barometer is founded on the Torricellian experiment, so called from Torricelli, the inventor of the instrument; which is simply a glass tube, first hermetically sealed, cased, or made solid, at one end, then filled with Mercury; the other end is left open, which is then immerged in a basin of stagnant mercury. Now, as a column of quicksilver, of about twenty-nine inches in height, is equal to the mean weight of the atmosphere, it is evident that every alteration in the latter must produce a proportionate alteration in the former.

In order to show this alteration in the most accurate and satisfactory manner, many learned and ingenious men had constructed barometers in various forms and on different principles, which have since been considerably improved by various artists.

TORRICELLIAN EXPERIMENT.

The weight or pressure of the air is exactly determined by the following experiment:—

Take a glass tube, near three feet in length, and open at one end; fill it with mercury, boiled and well-refined, and putting your finger upon the open end, turn that end downward, and immerse it into a small vessel of quicksilver, without letting in any air; then take away your finger, and the mercury will remain suspended in the tube 29½ inches above its surface in the vessel, sometimes more, and at other times less, as the weight of the air is varied by winds and other causes. That the quicksilver is kept up in the tube by the pressure of the atmosphere upon that in the basin is evident; for, if the basin and tube be put under a glass, and the air be taken out of the glass, all the mercury in the tube will fall down into the basin; and, if the air be let in again, the quicksilver will rise to the same height as before. Therefore the air's pressure on the surface of the earth is equal to the weight of 29½ inches depth of mercury all over the earth's surface at a mean rate.

That all descriptions of persons who are in possession of this valuable instrument, or that intend to become purchasers of it, may be enabled to use it to the best advantage, it is the design of the author to point out some of the discoveries of learned men, and also the result of a long series of minute inquiry and accurate observation.

The barometer is probably the most useful, entertaining, and interesting of all philosophical instruments. To the gentleman and man of leisure it is a source of perpetual amusement, as it enables him to determine with accuracy the weight of the atmosphere, and to observe its successive changes and variations; but more particularly it furnishes them with the plainest and easiest method of measuring the heights of mountains, and the depth of caverns and mines. The mariner and farmer, (men who deserve every assistance, encouragement, and protection, that government, the ingenious, and wealthy can confer upon them) will acknowledge, and generally confess, that the barometer is indispensable to those who are the least acquainted with its properties, as it indicates those approaching changes and alterations in the weather, the knowledge of which is of the utmost consequence —*a good barometer having often saved the former his vessel, and the latter his crop.*

LEONI'S DIRECTIONS

FOR THE

BAROMETER & THERMOMETER.

THE MARINE BAROMETER.

THE Marine Barometer was first invented by Dr. Hook, in 1700, for the express purpose of being used at sea. This instrument is highly spoken of and fully described by Dr. Halley, in the Philos. Trans. No. 269, where he says, "I had one of these barometers with me in my late southern voyage, and it never failed to prognosticate and give early notice of all the bad weather we at times experienced, so that I depended thereon, and made provision accordingly: and from my own experience I conclude, that a more useful contrivance hath not for many years been offered for the benefit of navigation."

The above instrument has been much improved by scientific men; it differs from the common one merely in having the bore of the tube smaller, for about two feet say one 20th part of an inch diameter, but above that height it is of the common size. Through the small part of the above tube the mercury is prevented from ascending too fast by the motion or lurching of a ship at sea, and the motion of the mercury in the upper or wider part of the tube is of course lessened.

Directions for fixing and unfixing a Marine Barometer on Board a Ship or Vessel.

The best place for fixing a Marine Barometer on board is a midships, say between the cabin windows, or opposite, if it can be done conveniently, as, in the first place, it is less liable to sustain injury there than at the side, and, in the next, the barometer will not be so much affected in that situation by the violent rolling or lurching of a ship in a heavy sea. But in cabins, where this cannot be done, it is advisable to nail something soft on that part of the ship's side against which the cistern of the instrument is likely to strike, for in a severe rolling sea it will be better protected from injury.

To fix a marine barometer, first take the improved brass arm,* keeping the hinge upwards, then secure it to the place where it is determined that the instrument shall be fixed, next take the barometer carefully, affixing it to the arm;† which done, turn the portable screw at the bottom of the cistern (see plate) from right to left, *a few turns at a time, but very slowly*, repeating the turns at intervals of four minutes, until it is quite unscrewed.

In unfixing or removing a barometer, it should be very carefully done—for this purpose turn the portable screw at the bottom of the instrument from left to right, and in a very cautious and gradual manner, only a *few turns at a time*, for by screwing the mercury up too quickly the tube will be liable to burst, and that with a considerable report, therefore repeat these operations at intervals of five minutes, until such time as you find the mercury within one-eighth of an inch of the top of the tube; then take the barometer from the brass arm, and slowly and carefully give it an inclined position until it lies horizontally, it may then be placed in its case for safety.

The following remarks to the curious in this instrument, are deduced from later and more minute observations of the motions of the barometer, and the consequent changes in the air of places situated to the northward or southward of 30 degrees of latitude.

In winter, spring and autumn, the sudden falling of the mercury, say 3-10ths of an inch, always denotes high winds and storms, but in the summer it presages heavy showers and thunder; it invariably sinks lowest of all when great winds prevail, though not accompanied with rain: it always falls more for wind and rain combined than for either of them separately. Also, if after strong wind and rain together, the wind should change in any part of the northern or southern hemisphere, accompanied with a clear and dry sky, and the mercury rise at the same time, it is a certain indication of fair weather.

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* This improved brass arm has been invented by the author for the proper suspension of the Marine Barometer, and it has been found to counteract considerably the effect produced by the rolling or lurching of a ship at sea.

† Marine Barometers are frequently made with spiral springs, (see Fig. 2) instead of the improved brass arm. These are cheaper than those with the arm, but as they require greater height in fixing, they are not so much used, excepting in ships that have lofty cabins.

In settled fair and dry weather (except the barometer should sink much) but little rain may be expected, for its small sinking then is only for a little wind, or a few drops of rain, and the mercury rises again to its former station.

In a wet season, suppose in hay-time and harvest, the smallest sinking of the mercury must be regarded; for when the constitution of the air is much inclined to showers, a little sinking in the barometer will denote more rain, as it never then stands very high; and if in such a season it should rise suddenly, very fast and high, the weather is only to be expected to continue fair for a day or two, then the mercury in all probability will fall again, and an immediate gale will follow, but the slow gradual rising for several successive days is mostly to be depended upon as indicative of about a week's fair weather.

Directions for the Marine Barometer.

The Barometer is an instrument for measuring the pressure of the atmosphere and elasticity of the air at any time.

It may be proper to premise, that it is not necessary so strictly to observe the words engraved on the barometer plate, as the rising or falling of the mercury, for should it stand at much rain, and then rise to changeable, it presages or foretells fair weather, although its continuance is not to be depended on so much as if the mercury were higher. But when it stands at fair, and sinks to changeable, it indicates bad weather, though not so much in proportion as if it had sunk lower. Therefore, in order to pass a right judgment of the weather, the point where the mercury stands is not so much to be regarded, but it should be particularly considered whether the mercury is actually in a rising or falling state. For its minutest alterations should be accurately attended to for the purpose of forming a right judgment respecting the weather expected to succeed.

When we would observe the barometer with accuracy, the tube should be first shaken* by gently tapping the front of the frame with the back part of the fingers, from three to five times—be cautious of striking the frame with the finger nails as it would deface it.

The atmosphere being dense or heavy, it will be found that the mercury had risen one-tenth of an inch, or thereabouts. If the atmosphere should have become more rarified or lighter, then the mercury in all probability would sink as much.

The greatest height of the mercury in the barometer tube, when situate in the northern hemisphere, happens upon easterly and north easterly winds.† However, on the contrary, when these winds prevail in the southern hemisphere, the mercury is at the lowest.

The mercury sinks when wind or rain is shortly expected from all the other points of the compass. However, it rises as the wind shifts about to the north or east in north latitude, and south and west in south latitude.

Should the mercury be found to sink on board ship with the wind in the above quarters, it will most probably change from thence and blow in a different direction, or else a heavy rain will ensue.

As the latitude advances towards the poles the range of the barometer gradually increases, till at last it amounts to two or three inches. In North America, however, the range of the barometer is a great deal less than in the corresponding European latitudes. In Virginia, for instance, it rarely exceeds 1.1.

* The attraction of the sides of the glass tube is sometimes so great that the mercury will not move without this stimulus.

† As in the North Atlantic Ocean, on this side the 35th degree of north latitude, the winds are generally westerly or south-westerly, so that here whenever the wind comes up at east or north-east it is always checked by a contrary gale so soon as it reaches the ocean. Consequently the air must accumulate over this island (Britain), and the mercury will stand high as often as these winds blow.

Rules for observing the Marine Barometer at Sea, or in Harbour.

I.—The mercury is usually low in calm weather, when rain is expected soon to follow.

II.—In moderate settled and serene weather the mercury mostly stands high.

III.—Against and during very high winds, although not accompanied with rain, the mercury sinks lowest.

IV.—The greatest elevation of the mercury in the northern hemisphere is perceptible during easterly or north easterly winds, excepting in heavy gales.

V.—In calm frosty weather the mercury mostly stands high.

VI.—When the position of the mercury is low, particularly after severe storms of wind, it usually rises very fast; this indicates moderate weather, but of short duration only. Should the mercury rise in a very gradual manner, fine weather may be expected for many days.

VII.—Between the tropics the changes or alterations in the weather make little or no variation in the height of the mercury, the winds being there extremely gentle, and they usually blow the same way.

VIII.—In situations northward of the tropic of Cancer, and also southward of the tropic of Capricorn, a greater alteration in the rising and falling of the mercury takes place.

IX.—The mercury in the barometer stands higher in cold weather than in warm; this takes place usually in the morning and evening rather than at mid-day.

X. In settled and fair weather it is found that the mercury stands *higher*, and it generally descends *lower* after rain than before it; this may be ascribed to the accumulation of vapours* with which the air becomes charged in the former case, which is ultimately dispersed by rain in the latter case. Should it rise higher after rain settled weather generally succeeds.

XI. If the atmosphere is impregnated with an unusual degree of heat, it becomes incapable of supporting a column of mercury so long as it did before the heat commenced, on which account the mercury sinks.

XII.—The mercury's being low indicates approaching rain, for the air being light, vapours are no longer supported thereby, but becoming heavier than the atmosphere wherein they floated, they descend, meet with other watery particles, incorporate, and at last form drops of rain.

XIII.—It is said that the mercury's being at one time lower than at another, is occasioned from two winds blowing at opposite points from the situation of the barometer, whereby the air of such place is carried two ways from it, and of course the cylinder of incumbent air is diminished, and causes the mercury to fall.

XIV.—The greatest height of the mercury is caused by two contrary winds blowing towards the place of observation, whereby the air of other places is brought thither, and combining with the air at the place of observation, accumulates, so that the incumbent cylinder of air is increased, and the mercury is thereby pressed upward.

XV.—The barometer falls suddenly before tempests, and undergoes great changes during their continuance.

XVI.—Considerable quantities of air being occasionally destroyed in the north polar regions when this happens, the atmosphere to the south rushes in to fill up the void. Hence S. W. winds take place, and the mercury falls in the barometer.

XVII.—The mercury is highest when the wind blows from the north or northwest at Calcutta.

XVIII.—The sudden fall and rise, or rise and fall, of the mercury, invariably indicates an extraordinary agitation in the atmosphere.

XIX.—It must be some alteration in the absolute weight of the atmosphere† to account for the rise and fall of the mercury, for if the wind were the sole agent, the alterations in the heights of the mercury would only be relative, as there would remain the same quantity supported at several places taken collectively; thus, what a barometer tube at Paris lost, another at London or Italy would gain. But we find the very contrary true, for, from observations repeatedly made, the barometers in several parts of the globe rise and fall together, so that it must be some alteration in the weight of the atmosphere to account properly for the rise and fall of the mercury.

---

* It has been observed that vapour is formed by a union of the elements of fire and water, by which the fire or heat is so completely enveloped by watery particles, that its action is entirely suspended; therefore the fire not only loses its properties of giving light and of burning, but it also becomes incapable of affecting the most sensible thermometer.

† Heavy dry exhalations from the earth must increase the weight of the atmosphere, and heighten its elastic force, as it is found that the specific gravity of menstrums are increased by dissolved salts and metals.

XX.—It is asserted that in the northern regions the variation is much more sensible than in the southern, the winds being more strong, more frequent, more various, and more opposite to each other in the former than in the latter.

XXI.—It is well ascertained that the variable winds prevail from the latitudes of 45° to 55° north and south, so that within these latitudes the greatest variation of the height of the mercury is perceptible. Of course, the rise and fall of the mercury decreases gradually from latitude 45° to the equator, and from latitude 55° towards the poles.

XXII.—It is found that near and under the line the mercury rises and falls from 2 or 3-10ths of an inch; in 15° north or south of the equator, 1 inch; in 30° north or south, 2 inches; in 45° north or south, 3 inches. However, in 60° north or south, the rise and fall diminishes to 2 inches; in 75° north or south, to 1 inch. But in 81° it diminishes to less than the 4th part of an inch.[*]

XXIII.—The mercury in the barometer varies in all latitudes from its observed station on board, with respect to an observation made with another barometer placed on shore in an elevated situation.

XXIV.—Periodical Rise and Fall of the Barometer.——Colonel Wright is said to have discovered, that within the tropics the mercury rises and falls twice within 24 hours, with such regularity as to afford almost an opportunity of measuring the lapse of time by this instrument.

Numerous instances might be published to show the value of a good barometer at sea, but the following will suffice:—

A Captain of a valuable ship bound to Europe says;—"When in latitude 33° N., and longitude 40° W., in the month of March, about six. a. m., observed the mercury had fallen 2 or 3-10ths of an inch; at this time the sky was clear; however it became lowering. Shortly after which a remarkable appearance of a circle round the sun engaged our attention. At this time all sails were set; proceeded immediately to take in sails, and prepare for a gale; by this time it began to blow excessively hard from the N. W. which lasted for about twelve hours. During this time we were lying-too, and although the quarter boat was made as secure as possible, by being made fast to the davit, yet the gale was so tremendous that the boat was washed away—but by the timely notice of the barometer we succeeded in saving our sails," &c.

⁂ It behoves every owner who sends a ship across the Atlantic to see that a barometer is placed in his ship previous to her sailing. Indeed this instrument is as necessary as the Mariner's Compass.

PROGNOSTICATOR, OR STORM GLASS,

A new curious instrument, formed of different compositions, which will exactly show the Weather; particularly high Wind, Storm, or Tempest. It will be preferable by Sea and Land, being portable,[†] and will be found to be very exact and useful.

Rules to be observed.

I.—If the weather is to be fine, the substance of the composition will remain entirely at the bottom, and the liquid will be very clear.

II.—Previous to changeable weather for rain, the substance will rise gradually, and the liquid will be very clear, with the appearance of a small star in motion.

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[*] In violent storms and heavy gales some deviation in the rise and fall of the mercury may be expected in all the above latitudes.

[†] Storm Glasses are cylindrical, and are placed in round tin cases about 13 inches long by 1 1-2 diameter.

III.—Before a storm or extraordinary high wind, the substance will be partly at the top, and will appear in form of a large leaf; and the liquid will be very heavy, and in a fermentation. This will give *twenty-four hours* notice before the weather changes.

IV.—In winter time, generally the substance will lie rather higher, particularly in snowy weather or white frost; the composition will be very white, with white spots in motion.

V.—In summer time, the weather being very hot and fine, the substance will be quite low.

VI.—To know which quarter a wind or storm came from, you will observe the substance will lie close to the bottle on the opposite side to that quarter from which the storm came.

Observations have been made on the Storm Glass, and it has given much satisfaction, both at sea and on shore, but like the Barometer it should be regularly watched at alternate periods.

TESTIMONIALS.

COPY OF A LETTER FROM VICE ADMIRAL SIR ROBERT CALDER.

"His Majesty's ship Goliath was at anchor in Quiberon Bay, when a heavy gale of wind came on. The ship brought home her anchor; she let go a second, and a third, but had no effect, the ship still drifting and going ashore, seemingly without a probability of being saved. Captain Durham, in his Majesty's ship Defence, was at the same anchorage, but unable to render the Goliath the smallest assistance; he having one of these curious instruments (or storm glass) on board, perceived it announced that the gale was going to abate, and in consequence made the signal thereof to Captain Brisbane, who was then preparing means to endeavour to save the lives of the Goliath's crew. Within a quarter of an hour after the signal was made the storm did abate, and the Goliath rode in perfect safety."

An experienced commander of a free trader, during a voyage from Rio Janeiro to New South Wales, when in latitude 40° 28′ S. and longitude 29° 19′ E. says—"Hitherto I have omitted to make remarks on the Storm Glass, but it has indicated the weather being *bad* or *fine* very well. Yesterday it settled fast, and to-day is the finest by far we have experienced since leaving Rio Janeiro."

ON THE MEASUREMENT OF ALTITUDES

BY THE

MOUNTAIN BAROMETER,*

Accompanied with attached and detached Thermometers.

A very important property of this valuable instrument is that of determining heights, and its accuracy is inferior to no other mode; on this account, it is not only very useful to surveyors, but highly entertaining to philosophers, scientific men, &c.

Measurement of Altitudes.

It is found that the mercurial heights of the barometer vary according to situations either more elevated or more depressed. Hence this instrument serves to determine how much higher one place is than another.

The Law of the Dilitation of the air was discovered by M. Mariotte previous to the year 1676, improving from Mr. Boyle's Experiments, which were published in 1661. The law of the dilitation of the air is now generally admitted by philosophers, and is confirmed by observations made in all climates and various altitudes.

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* The mercury stands higher in tubes of a larger bore than in those of a smaller, and it is obvious, when experiments are made with different barometers, some attention should be paid to the different diameters of their tubes; it is desirable they should be alike, not less than one-fourth of an inch, nor to exceed one-third of an inch.

M. Marriotte applied this general law of electricity to the investigation of the total height of the atmosphere. He therefore collected many observations made with the barometer at small heights, and he was the first person who suggested the use of logarithms in calculating heights by the descent of the mercury in the barometer. However, this method has generally been ascribed to Dr. Halley, and Dr. Halley did indeed first employ tables of logarithms in the estimation of atmospherical altitudes—see Phil. Trans. No. 181. The Doctor assuming the specific gravity of the air to water, when the barometer stood at 30 inches, and in a mean state of heat and cold, to be as 1 to 800, and that of mercury to water as 13 and ½ to 1; so that the weight of mercury to air is as 10.800 to 1, or a cylinder of air of 10.800 inches, or 900 feet, is equal to an inch of mercury. He inferred from these premises, that if the air were to be of equal density like water, the whole atmosphere would then be no more than 5.1 miles high, and that for an ascent for every 900 feet the mercury in the barometer would sink one inch.

But the expansion of the air increasing in the same proportion as the incumbent weight of the atmosphere decreases, therefore the upper parts of the air are much more rarified than the lower, by which each space corresponding to an inch of mercury is gradually enlarged, and therefore the atmosphere must be extended to a much greater height.

It is probable that no part of the atmosphere reaches above forty-five miles from the surface of the earth, but at a greater distance its rarity is so great that its resistance would be insensible, though the retardation occasioned by it has been accumulating for ages. At the distance of 500 miles the rarity is said to be so great, that a cubic inch of common air, expanded to that degree, would occupy a sphere equal to the orbit of Saturn; hence it is with reason inferred, that the visible universe is occupied by air, which, by its gravitation, will accumulate about every body in it, and that in a proportion depending on their respective quantities of matter, for the larger bodies will attract more than the smaller ones, thus forming an atmosphere about each of them.

It is fully ascertained that the weight of the atmosphere differs at different times. This variation is ascribed partly to the effect of heat and cold, and also to the influence of various mixtures of aqueous and other vapours, for when the air becomes rarified by heat, the vapours are most copiously raised, so that though the atmosphere properly so called be expanded, and consequently become lighter, yet its interstices being crowded with vapours and other matter specifically heavier together with the atmosphere, may in all probability continue much the same in density as before, for an indefinite time.

The reader is here presented with the result of some experiments made by the following gentlemen:—

Mr. Caswell measured the height of one of the Snowdon Hills in Wales, and found it to measure nearly 1240 yards, or 3720 feet, the barometer standing at 25.6 inches:—Another mountain measures 3567 feet.

Dr. Halley found by three exact trials, that the mercury stood lower at the top of Snowdon than at the bottom by three inches and eight-tenths, from which it appears, that every thirty-two yards ascent sinks the mercury about one-tenth of an inch.

Dr. Derham, from experiments made by him at the top and bottom of the Monument in London, allows thirty-two yards perpendicular ascent to one-tenth of an inch in the fall of the mercury.

M. De Luc, in the first volume of his Researches, has given a curious table of the heights of the atmosphere, corresponding to those of the mercury in the barometer, calculated on the principles of various philosophers, from twenty-eight inches, the height observed on the coast of Peru by the French Academicians to 15.10 inches, the height observed by M. De La Condamine on the top of one of the Cordilleras, and in his second volume further information may be found on this subject.

M. Bourguer, member of the Royal Academy of Sciences in France, 1553, gives us the result of the experiments made by himself, and M. De La Condamine in America—they found that the elasticities of the same mass of air exactly corresponded to the ratio of its densities.

Dr. Nettleton, from experiments made in the neighbourhood of Halifax, formed the following Table;—

A TABLE,

Shewing the number of feet required to make the mercury fall 1-10th of an inch from any given height in the tube, from 31 to 26 inches.

Inches		Decim.	Feet		Decim.	Inches		Decim.	Feet		Decim.	Inches		Decim.	Feet		Decim.
31	“	0	82	“	26	29	“	3	87	“	03	27	“	6	92	“	41
30	“	9	82	“	53	29	“	2	87	“	33	27	“	5	92	“	74
30	“	8	82	“	79	29	“	1	87	“	63	27	“	4	93	“	07
30	“	7	83	“	06	29	“	0	87	“	93	27	“	3	93	“	41
30	“	6	83	“	33	28	“	9	88	“	24	27	“	2	93	“	76
30	“	5	83	“	61	28	“	8	88	“	55	27	“	1	94	“	12
30	“	4	83	“	89	28	“	7	88	“	89	27	“	0	94	“	47
30	“	3	84	“	16	28	“	6	89	“	17	26	“	9	94	“	82
30	“	2	84	“	44	28	“	5	89	“	49	26	“	8	95	“	17
30	“	1	84	“	72	28	“	4	89	“	81	26	“	7	95	“	53
30	“	0	85	“	0	28	“	3	90	“	13	26	“	6	95	“	89
29	“	9	85	“	29	28	“	2	90	“	45	26	“	5	96	“	25
29	“	8	85	“	58	28	“	1	90	“	76	26	“	4	96	“	61
29	“	7	85	“	86	28	“	0	91	“	09	26	“	3	96	“	98
29	“	6	86	“	16	27	“	9	91	“	42	26	“	2	97	“	36
29	“	5	86	“	45	27	“	8	91	“	75	26	“	1	97	“	73
29	“	4	86	“	74	27	“	7	92	“	08	26	“	0	98	“	10

From this table it is evident, that the density or weight of the atmosphere is not every where equal, but that the higher we ascend the rarer it becomes; and as it is founded upon the actual observations of a very ingenious and accurate philosopher, we may derive great use from it in all our barometrical calculations.

The late Dr. Maskelyne's Rules for taking altitudes by the Mountain Barometer:—

1. Take the difference of the tabular logarithm of the observed heights of the barometer at the two stations, considering the four first figures, exclusive of the index, as whole numbers, and the remaining figures to the right as decimals.

2. Take the difference of the attached thermometer (Farenheit's scale), multiply this difference by 0.454, and subtract the product from the quantity found at first if the upper thermometer is lower than the thermometer below, but add it if the mercury in the upper is above that in the lower thermometer.

3. From half the sum of the detached thermometer subtract 32° (the standard), and multiply the remainder by 0.00244, add the product to 1, and by this sum multiply the quantity found by the first and second parts of the rule, the result will be the height of one station above the other in fathoms.

AN EXAMPLE,

Showing the height of Richmond Hill, in the county of Surrey, by T. Jones's Method of using the Mountain Barometer.

	Barometer.	Height.	THERMOMETERS.	
			Attached.	Detached.
Bottom of Richmond Hill, or river side	29.924 B.	920.	69.0 L. 62.0 U.	65.00 L. 60.75 U.
Top of the hill	29.750 T. × 041		7.0 .0058	125.75
	29.791	1037.	.04060	62.875 ×.5
		117. 31.4375		31.4375
	Height of the hill	148.4375		

Height of Richmond Hill is therefore 148.4 feet.

An Account of other Barometers, namely, the Double, Horizontal or Rectangular, Inclined or Diagonal, Pendant, &c., &c.

Barometer is compounded from two Greek words, signifying weight and measure.—It is an instrument for measuring the weight of the atmosphere and its variation, in order chiefly to determine the changes of weather, and the height of mountains, &c.

COMMON BAROMETER.—This instrument was invented by Torricellius[*] in 1643. The common barometer is suitable for public institutions, libraries, chambers, halls, &c., and serves for observing, when properly fixed, the changes of the atmosphere, but is not adapted, unless made portable, for removal from one place to another without the greatest care. To this instrument is sometimes attached a thermometer, and also an hygrometer (an instrument to measure the degrees of moisture), each of which may be separated when wanted to be used apart. The hygrometer will be found very useful to travellers, especially invalids, when stopping at inns, to discover whether beds are damp or not.

DOUBLE BAROMETER.—Invented by Dr. Hook in the year 1668, and its description may be seen in the Phil. Trans. No. 185. It is subject to several inaccuracies.

HORIZONTAL OR RECTANGULAR BAROMETER.—The tube whereof is bent in form of a square; the first inventor was Cassini, but it was first published by M. J. Bernouilli in the year 1710.

INCLINED BAROMETER OR DIAGONAL.—Invented by Sir Samuel Moreland. See Mr. Orme's Experiments, Phil. Trans. Abr. Vol. 8, p. 455.

WHEEL BAROMETER.—Invented by Dr. Hook in the year 1668, and very suitable for a parlour, counting-house, or hall, &c. A wheel barometer, made in the best manner, diameter of plate either eight, ten, or twelve inches, having a Thermometer, Hygrometer, Spirit Level or Time-piece, attached, all of which are usually fitted up in a frame highly polished or varnished, has a very handsome appearance.

⁂ These instruments should be made in the very best manner, and an extra sum is not thrown away in the purchase to have them of the best construction.

For an account of an improved Wheel Barometer by Mr. Fitzgerald, F.R.S., see Phil. Trans. Vol. 52, Part I. No. 59, and Vol. 60, No. 10.

PENDANT BAROMETER.—Invented by M. Amontons in 1695. This instrument is considered more curious than useful.

MARINE BAROMETER by Dr. Hook in 1700. See page 6.

A BAROMETER by Mr. Caswell, described in the Phil. Trans.

A BAROMETER by Mr. Rowning. See Phil. Trans. No. 427.

A BAROMETER invented by Alex. Keith, Esq., F.R.S. and F.A.S., Edinburgh. The weight of the atmosphere at great heights might be discovered by suspending this instrument to an air balloon. Edinb. Trans. Vol. 4, 1798.

SELF REGISTERING BAROMETER, by the Rev. Arthur M'Gwire. See Irish Trans. Vol. 4, p. 141.

M. MAIRANS'S REDUCED BAROMETER, only 3 inches long. Instruments of this kind are used in air-pumps.

M. DE LUC'S BAROMETER—which is described in detail by him. See his Researches, Vol. 2, pages 6, 49, 54, &c.

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[*] Galilæo, a mathematician of Pisa in Italy, maintained as an undeniable truth in philosophy, that no heavy body ascended without another body equally heavy descending in counterpoise to it. This hint was improved by Torricelli, or Torricellius, a Florentine, who, amongst other experiments for discovering the weight of the air, formed the first rough model of a barometer in a pipe or tube of 60, and afterwards 40 feet in length, which being immerged and suspended in a vessel of water, and the air extracted by a sucker, the water was always observed to follow the sucker, and to rise and continue suspended within the tube to the height of 32 or 33 feet, with some little variation, but could by no art be drawn or kept up to the height of 33 or 40 feet. But this instrument of Torricellius being of an unmanageable length and size, and requiring the help of a windmill sail to invert the tube, by comparing their specific gravities, and filling a tube of glass with quicksilver instead of water (which some authors say was accidental), he found the effect equally to answer, and by the advantage of so heavy a fluid he reduced the barometer in its length from 40 feet to 32 inches. This was the state in which Torricellius left the barometer, and is usually called the "Torricellian Experiment." But the honour of improving the barometer to a greater degree of exactness and perfection was done afterwards by Mr. Boyle.

A MOUNTAIN BAROMETER.—Invented by Dr. J. A. Hamilton. See Trans of the Royal Irish Academy, Vol. 5, p. 95.

SYMPIESOMETER, OR IMPROVED AIR BAROMETER.—Invented by A Adie, Esq. F.R.S. Edinb. in 1816. Two recommendations to this instrument are its portability and sensibility. It is inclosed in a mahogany case, the exterior dimensions of which are 2 feet 1 inch long, 3¼ inches wide, and 1⅜ inch deep. That for measuring mountains is inclosed in a brass cylindrical case, about 25 inches long by 1¼ inch diameter.—See Directions, page 17.

An OIL BAROMETER.—Invented by Thos. Jones, Esq., London, 1821. This is similarly constructed with the Sympiesometer, and the exterior mahogany case measures 1 foot 5¼ inches long, 3¼ inches wide, and 1⅜ inch depth. See Directions hereafter.

The ENGLEFIELD MOUNTAIN BAROMETER, by T. Jones, Esq.

TWO BAROMETERS, one of which marks the maximum of elevation, the other that of depression, during the absence of the observer, by the Chevalier Landriani.—See Royal Quarterly Journal, No. 6, p. 399.

THE STATICAL BAROMETER, supposed to be the invention of the great Mr. Boyle.

An improved Brass Arm for the Suspension of a Marine Barometer.

THE HOUSE BAROMETER,

In serene calm weather, the air has weight enough to support a column of quicksilver 31 inches high; but in tempestuous stormy weather, not above 28 inches. The quicksilver, thus supported in a glass tube, is found to be a nice counterbalance to the weight or pressure of the air, and to show its alterations at different times. And being now generally used to denote changes in the weight of the air, and of the weather consequent upon them, it is called the Barometer or Weather Glass.

The pressure of the air being equal on all sides of a body exposed to it, the softest bodies sustain this pressure without suffering any change in their figure; and so do the most brittle bodies without being broken.

Directions for using the Common House or Wheel Barometers, generally called Weather Glasses.

1.—The rise of the mercury mostly indicates fair weather, but the falling of it unsettled weather, as sleet, rain, snow, hail, strong winds, and storms.

II.—In sultry weather, when the mercury falls, lightning and thunder may be expected.

III.—In the winter, the rising of the mercury indicates frost; however, should it fall 3 or 4-10ths of an inch during a frost, a thaw will certainly follow. But in continued frosty weather, should the mercury then rise, it will surely snow.

IV.—When soon after the falling of the mercury unsettled weather occurs, expect a short duration of it, when it proves fair shortly after the mercury has risen it will not be of long continuance.

V.—In bad weather, when the mercury is in a rising state, continuing so for two or three days, a succession of fair weather may be expected.

VI.—In fair weather when the mercury is in a falling state, continuing so for the space of two or three days previous to rain, in such a case a great deal of falling weather may be expected, accompanied probably with high winds.

VII.—Changeable weather, uncertain respecting its duration, is indicated by the unsettled state of the mercury.

VIII.—During wet weather, when the mercury is in a rising state, it should appear convex or higher at its centre than at its sides, this indicates that the pressure of the air is then increasing, and an interval of fair weather may be expected soon to follow.

IX.—If the mercury should appear concave or hollowed, it signifies that it is in a falling state, for the pressure of the air is then decreasing, and the weather will probably in a few hours be overcast, accompanied with rain or wind, or both.

X.—Should the mercury appear level in the tube, the pressure of the air may be estimated to be steady or equal, it may therefore then be considered stationary.

XI.—In very hot weather the fall of the mercury indicates thunder.

XII.—In order to make the observation with more accuracy, tap the barometer gently as before directed—see page 7.

XIII.—When snow or rain abounds the mercury has been found at the lowest, and though an easterly or north-easterly wind was then blowing, yet the mercury sunk little or none, and after this, when the mercury has been perceived to be in a rising state, the above winds have soon arrested its progress.

XIV.—When the mercury stands low in the barometer much rain is to be expected.

XV.—The range of the barometer is greater in winter than in summer.

The variations of the barometer at the following places is very remarkable:—

At Naples the rise seldom exceeds one inch.

At Upminster there is a difference of 2½ inches.

At St. Petersburgh there is a difference of 3 inches and about 11-10ths.

In the northern parts of France the variations are greater than in the southern

At Peru, under the equator, and at the level of the sea, the variations amount to 2 or 3-10ths of an inch only, but in other parts, namely, within a few degrees of the line, on the approach of the rainy season or hurricanes, the barometer is said to fall an inch or more.

Between the tropics the variations of the barometer are exceedingly small; and it is remarkable, that in that part of the world it does not descend above half as much for every 200 feet of elevation as it does beyond the tropics.

Remarks on the Barometer, &c.

M. Planer observed the barometer for a whole year, six times every day, viz. at two, six, and ten o'clock in the morning, and at the same hours in the afternoon, and found in general, that the barometer, between ten in the morning and two in the afternoon, and between ten at night and two in the morning, was less in its rising and greater in its fall; and that the contrary was the case between the hours of six and ten in the evening and morning.

Hemmer deduced the three following general rules from a great number of accurate observations.:—

1st, When the sun passes the meridian, the barometer, if in the act of falling, continues to fall, and the falling is accelerated.

2d, When the sun passes the meridian, the barometer, if in the act of rising, falls, or becomes stationary or rises more slowly.

3d, When the sun passes the meridian, the barometer, which is stationary, falls, if it has not risen before or after being stationary; in which case it usually becomes stationary during the sun's passage.

The celebrated Humboldt made some interesting observations at Caraccas, South America, near the equator. There are, he says, four atmospherical tides every 24 hours, which depend only on the attraction of the sun. The mercury falls from nine in the morning to four in the evening; it rises from four to eleven o'clock, it falls from eleven o'clock till past four in the morning, and it reascends from that time till nine o'clock. *Neither winds, storms, nor earthquakes, have any influence on this motion.*

James Horsburgh, Esq., F.R.S., and Hydrographer to the Hon. East India Company, in his last voyage to Bombay, employed two marine barometers, with which he made very minute observations. See Philosophical Transactions, 2 part, 1805; also in the Hist. Royal Society Edinburgh, for the same year.

INTERESTING WORK TO METEOROLOGISTS.

Meteorological Essays and Observations, by J. F. Daniel, F.R.S.

Mr. Daniel, after showing separately what phenomena would result, supposing the atmosphere to be simply a *dry* elastic medium; and another, if it were of *aqueous vapour* only, combines the two (as it really exists), and proceeds with his inductions, which are no less creditable to his philosophical acumen than his perseverance. The labour and intensity of application requisite for the calculation of the numerous tables which accompany these essays, can only be appreciated by those who have devoted some considerable attention to similar pursuits.

The only portion of Mr. D.'s remarks that we can afford room to extract, are a few of the general laws or axioms he has submitted to the reader under the head of "Particular Phenomena of the Atmosphere of the Earth." These axioms are severally illustrated by brief remarks, but we can only admit the text, leaving our readers to apply their own illustration.

1. "The mean height of the barometer, at the level of the sea, is the same in every part of the globe.

2. "The barometer constantly descends in a geometrical progression for equal ascents in the atmosphere, subject to a correction for a decreasing temperature of the elevation.

3. "The mean temperature of the earth's surface increases gradually from the poles to the equator.

4. "The mean temperature of the atmosphere decreases from below upwards in a regular gradation.

5. "The barometer, at the level of the sea, is but very slightly affected by the annual or diurnal fluctuations of temperature.

6. "The barometer, in the higher regions of the atmosphere, is greatly affected by the annual and diurnal fluctuations of temperature.

8. "The average quantity of vapour in the atmosphere decreases from below upwards, and from the equator to the poles.

9. "The condensation of elastic vapour into cloud, raises the temperature of the air.

10. "The western coasts of the extra-tropical continents have much higher mean temperature than the eastern coasts of the same continents.

12. "In latitudes below 30, the winds always blow either from N. E. or S. E. towards the equator.

14. "A current always blows in a contrary direction to the trade winds, at a great elevation.

15. "A wind generally sets from the sea to the land during the day, and from the land to the sea at night; especially in hot climates.

18. "Between the tropics, the fluctuations of the barometer do not much exceed a quarter of an inch, while beyond this space they reach three inches.

24. "The variations of the barometer are less in high situations than in those at the level of the sea. (?)

25. "In Great Britain, upon an average of ten years, the westerly winds exceed the easterly, as 225 : 140.

28. "Northerly winds, almost invariably, raise the barometer, while southerly winds constantly depress it.

30. "The elasticity of aqueous vapour does not decrease gradually as we ascend in the atmosphere, in proportion to the decrease of temperature and density of the air; *but the dew point remains stationary to great heights*, and then suddenly falls to a large amount.

33. "The apparent permanency and stationary aspect of a cloud is often an optical deception, arising from the solution of vapour on one side of a given point, while it is precipitated on the other.

34. "The quantity of vapour in the atmosphere in the different seasons of the year, measured on the surface of the earth, follows the progress of the mean temperature.

35. "The pressure of the aqueous atmosphere, separated from that of the aërial, generally exhibits directly opposite changes to the latter.

36. "Great falls of the barometer are usually attended by a rise of temperature above the mean heat of the season; and a great rise of the barometer by a depression of temperature."

We have omitted nearly one half of the thirty-six axioms, considering them as sufficiently trite and well known without enumeration.

INSTRUCTIONS

FOR THE

SYMPIESOMETER,* OR NEW AIR BAROMETER.

(Abridged from the book usually given with the instrument when purchased).

When the Sympiesometer, is hung up for observation, the glass cistern must be opened by taking out the cork, giving it five minutes to settle—then observe the temperature by the thermometer attached to the instrument, and set the index or flower-de-luce, which, in the common or marine Sympiesometer, is at 29½ inches, upon the sliding scale, opposite to the degree of temperature on the fixed scale; the height of the oil, as indicated on the sliding scale, will be the pressure of the air at the moment.

Suppose the temperature observed by the mercurial thermometer to be 52°.4, then slide the Sympiesometer scale until the flower-de-luce points to 52.4 on the fixed scale at the right hand side (on which read the numbers downward), and the top of the column of red fluid stands opposite to the second division above the third tenth higher than the number 30. The height of the barometer is then 30 inches 3 tenths and 4 hundredths of an inch, or 30.34 inches. The tenths are easily distinguished from the hundredth parts, by the lines being drawn longer. When the column of oil descends, bad weather may be expected: and when it rises, the weather will, in general, be fine.

In the Sympiesometer, for measuring heights, the scale is divided into parts corresponding to the increase in bulk which takes place in the gas by the diminishing pressure of the atmosphere on ascending towards a given height, the temperature being 32° of Farenheit.

In order to ascertain the height of one place above another, by the Sympiesometer, it should be placed in the shade, as the observation is frequently deranged by the direct influence of the sun; and let it be suspended by the ring at the top. The cistern should now be opened, by pushing up the pin that raises the stopper, and the instrument should be allowed to remain four or five minutes before the observation is begun, that it may acquire the temperature of the surrounding air: Then set the index, which is on the narrow part at the top of the sliding scale, to the same degree as the temperature indicated by the thermometer, and note the number on the fathom-scale,* corresponding with the top of the column of oil in the sympiesometer tube; this completes the first observation. Before taking down the instrument, push down the stopper, to prevent the escape of the oil from the cistern.

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* The Sympiesometer is a valuable instrument to compare either with the Marine or House Barometer, but it in general ranges higher.

As an example may be useful to those persons who have not been accustomed to measure heights by the barometer, observations made to ascertain the height of Arthur's Seat, from its base at the Duke's Walk, are subjoined.

The Sympiesometer at the top of the hill stood at	244 fathoms
The Sympiesometer at the Duke's Walk	134
Subtracted from the former leaves for the height	110 fathoms

which would have been the correct height, if the temperature of the air had been 32 degrees.

The following is the method of finding the necessary correction for the difference of temperature.

Temperature at the foot of the hill	52°
Temperature at the top of the hill	48
2	100
Mean temperature of the two observations	50
Subtract	32

Difference between mean temperature and 32 degrees - - 18 this multiplied by .00245 gives the whole length of a column of air previously of one fathom in altitude, and of the temperature of 32°, equal to 1.04410 fathoms at the temperature of 50°. 00245, being the quantity that a column of air of the temperature of 32°, and of one fathom in altitude, is expanded by an increase of one degree of temperature; which last number, multiplied by 110, the number of fathoms before found, gives the corrected height 114.85 fathoms; differing from the true height, as ascertained by my friend Mr. Jardine with the utmost accuracy, only 68 hundredths of a fathom, the true height being 114.17 fathoms.

Or the above correction may be found in the following way:—As the mean expansion of air at the ordinary temperature is equal to the 435th part of its bulk for one degree of heat, divide 110, the number of fathoms given as the approximate height, by 435; the number found will be the expansion of the whole column of air by an increase of one degree of temperature, which, in this case, will be 0.2528; and this number, multiplied by 18°, the number of degrees that the mean temperature of observation was above 32°, gives 4.55 fathoms to be added to the approximate height, which makes the height of Arthur's seat from the Duke's Walk 114.55 fathoms, differing from the true height only 38 hundredths of a fathom.

Another instance of the importance of having a Marine Barometer on board a ship:—"His Majesty's ship Phæton was struck by lightning while lying at the Mole at Gibraltar, on Sept. 13, 1834. The rapid fall of the barometer indicated an approaching storm; the weather continued to wear the same threatening aspect through the whole of the 15th, with very heavy squalls occasionally. At 8 o'clock in the evening a tremendous black cloud was observed slowly moving along the side of the rock shaping its course towards the Mole, &c.—See also p. 9.

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* By the fathom-scale the approximate height will be given, without the aid of a table of logarithms, by subtracting the number of fathoms indicated by the Sympiesometer at the under station from that indicated at the upper station, the difference being the number of fathoms which the one station is above the other.

THE THERMOMETER.

The Thermometer is an instrument for measuring the heat and cold in the air, or the temperature of the atmosphere, and also to ascertain the temperature of the sea, &c.

The invention of the thermometer has been attributed to several persons, about the beginning of the seventeenth century. But whoever had the honour of inventing this instrument, it was certainly at first very imperfect.

Thermometers are now much improved, and seem to approach a state of perfection; they vary in construction according to the uses for which they are intended.

When the thermometer is appreciated according to its worth, it will be found in the possession of all judicious captains and mates in the merchant sea service. Therefore, in order that this nautical instrument may come into general use, some of its valuable qualities whereby it may be found very useful at sea are here enumerated.

It is well ascertained, that in making a passage from the West Indies, the thermometer is the best guide to know when you are clear of the Gulf Stream, as the water is warmer in the stream than out of it.

The captain of a ship, which arrived in April 1824, informed me that as soon as he got soundings in the British Channel, the thermometer indicated a difference of two degrees colder. This must have been occasioned by his approach to land.

Thermometer affected by an Earthquake.—The thermometer is affected by the convulsions of nature, as may be seen by the following:—

"Missolonghi, Feb. 10, 1824.—This afternoon, about three o'clock, we felt a violent shock of an earthquake, which ran in a direction from north to south. During the shock the thermometer fell from 50 to 39 degrees (Farenheit's scale)."

Remarks on Thermometrical Navigation, by John White, Esq. Lieut. U. S. N. (Appendix No. II.).

He commences—"On this interesting subject, which, to the reproach of the maritime world, has scarcely yet progressed beyond hypothetical conjectures, my principal object is to promote, among nautical men, a spirit of inquiry and experimental investigation into the physical causes and effects of the aërial and aqueous temperature of the globe in various places, climates, and seasons; and to induce them to make such observations and remarks as may concur in producing a System of Thermometrical Navigation.

"Some interesting information on this subject was published about thirty years since by Mr. J. Williams, and his remarks, with abstracts from his journals, were read before the Philosophical Society of Philadelphia in Nov. 1790.—See Ann. Phil. Trans. Vol. III. p. 82 to 194.

"From my own remarks, combined with Mr. Williams's, Dr. Davey, &c., I wish to make known the following:—

I.—"The water over submarine banks, detached from continents or islands, and surrounded by deep water, is always much colder, or, according to modern philosophy, does not contain as much caloric as that over banks stretching out from and connected with islands.

II.—"The temperature of the water over these detached banks is in proportion to their respective extents, and the depth of water over them. The water over the smaller banks, though colder than that of the circumjacent ocean, is not so cold as that over larger ones of the same depth, the cold increasing in a progressive ratio with their greater extent.

III.—"The water over banks stretching out from and connected with continents or islands, is colder or warmer in proportion to its depth, e. g. In approaching a coast, where the depth diminishes gradually, the water becomes colder in proportion to the approach to it, and the contrary.

IV.—"The waters of deep Mediterranean seas, where soundings extend but a short distance from land, which are surrounded by mountains, consequently less agitated than the oceanic waters, and are discerned by reflection from the circumjacent lands, experience but little variation of temperature. Notwithstanding this, however, the water of these seas are colder on soundings than off.

V.—"Shallow Mediterranean seas, especially within the tropics (the Java sea, for example), are penetrated by the sun's rays, and their temperature, consequently approximates near to that of the superincumbent air, the water of these seas is, however, colder than that of the main ocean off soundings with the same temperature of air.

VI.—With modifications, as respects the relative position of the observer, with regard to wind and current, the air and water, in the immediate vicinity of ice islands, when on or off soundings, are colder than those which are found more remote from them.

VII.—"The water of the ocean on our Atlantic coasts, off soundings, is about 10° warmer than that of the coast on soundings, and about 10° colder than the Gulf stream,* these different degrees of temperature according to the season of the year, e. g. Mr. Williams found the water of Cape Cod, in August, to be 58°, and at sea it was 69°; in October the water of Cape Cod was 48°, and at sea 50°. These relative differences should be always attended to.

"From the above premises I am inclined to conclude, that the thermometer may be made an important agent in the navigation of coasts, to warn seamen of their approach to ice islands, and to assist them in correcting their reckonings on banks in the ocean, e. g. in the latter case, after sailing from St. Salvador (Brazil) in the Franklin, on the evening of the 25th of February, 1819, at eight o'clock, the temperature of the air was 79°, and that of the water was 77°; at half past eight the water was 72°, and at nine it was 68°, when we sounded in 21 fathoms on the Abrohlas bank, at ten o'clock the air was 77°, and the water 76°, and so continued till midnight. As we knew our position previous to coming on the bank, we were prepared to make these experiments. The discolouration of the water could not be perceived by reason of darkness; the thermometer was the first index of our arrival on the bank, as it also indicated the time of passing off it; and it will be observed, that the temperature of the water altered as we ascended on the bank, and as it was colder at the time of sounding than either before or after, we may infer that this was the shoalest water we had sailed over.

"I have used the thermometer on the Lagullas, or Aguilhas bank, eastward of the Cape of Good Hope,† with good effect, especially on my passage home in the Franklin. It was in the stormy month of June; our vessel was deeply laden, and we had previously contended with some severe gales from the westward. We had arrived, according to our calculations, as far as Cape False. The weather was thick, a fresh gale blew from W. S. W. night was coming on, and the water appeared somewhat discoloured, but its temperature, which had been 46° at noon, was now 54°. This determined me to stand on.

"For obvious reasons, the water in a ship's *wake* should always be used for observations on the temperature of the ocean."

Jamieson's Marine Thermometer, enclosed in a copper case, should be in general use.

For other very interesting Meteorological information the reader is referred to "A Voyage to Cochin China, by John White, Lieut. U. S. N."

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* See Dr. Franklin's remarks on the subject, in the 2d Vol. of the American Phil. Trans.

† The Colony of the Cape of Good Hope is situated at the most southern extremity of Africa. It is about 550 miles in length, from west to east, and 233 in breadth, from south to north. It lies between 30 and 34 degrees and a half of south latitude, and 18 and 28 of east longitude from the meridian of Greenwich. It is bounded on the east by Caffraria, on the north-east and north, by an extensive country called the Boshesmens country; and to the north-west, near the the Atlantic Ocean, by the Namacqua country; on the west, by the South Atlantic Ocean, and on the south by the Indian Ocean.

Dr. John Davy, during his recent voyage to Ceylon, found, on approaching the land of Table Bay, at the Cape of Good Hope, that the temperature of the sea by the thermometer decreased 2°, and it also decreased 2° when the island of Ceylon was closely approached.

Remarks on the different Thermometrical Scales, &c.

☞ The different scales by which the principal thermometers are divided may be seen in the engraving opposite the title-page.

Farenheit's* Thermometer is generally used in the United States and Great Britain; the freezing point is at 32, and the boiling point at 212. Reaumer's Thermometer is generally used on the continent of Europe; the freezing point is placed at 0, and the boiling point at 80. Celsius's Thermometer is used in Sweden, and has lately been adopted in France under the name of the Centigrade Thermometer; the freezing point is at 0, and the boiling point at 100.—De La Hire's, the freezing point is at 28, and the boiling point at 199½. Amoreton's, the freezing point is at 51½, and the boiling point at 73. Crucquius's, the freezing point is at 1070, and the boiling point at 1510. Sir Isaac Newton's, the freezing point is at 0, and the boiling point at 34.——See Carvallo's Natural Philosophy, Vol. III. pages 19 and 20, and for an accurate mode of constructing thermometers see Phil. Trans. Vol. 67, page 816. For an interesting account of the "Influence of Atmospheric Pressure on the Bulbs of Thermometers, see Edinb. Phil. Journal, Vol. 8, page 397, Vol. 9, p. 196, and No. 18, p. 398.

The following TABLE exhibits the result of several Observations on the Temperature of Air, and of the Sea, at different depths, in several latitudes, and at various seasons of the year.

Latitude.	Season of the year.	Heat of the Air.	Depth of the Sea.	Heat of the Sea.	Heat of the Surface. FAR.
			Feet		
57° 0 N.	Jan. 8	46° 0	6	40°	37°
57 0	10	43 6	50	43 6	43 6
55 40	20	47 0	110	51 5	40
39 30	28	53 0	110	59 0	59
2 55	Feb. 25	81 0	58	81 0	81
2 50	26	83 0	110	81 0	84 5
67 0	June 20	48 5	4680	26	
78 0	30	40 5	708	31	
80 30	Aug. 4	32 0	480	39	36
24 40 S.	27	72 5	640	68	70
69 0 N.	31	59 5	4038	32	
66 0	Sept. 4	66 5	5464	40	55
Equator.	5	75 5	510	66	74
24 0 S.	26	72 5	480	70	70
34 4	Oct. 11	60 5	600	57	59
58 24	Dec. 27	31 0	1280	34	32

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* Gabriel Daniel Fahrenheit was a native of Hamburgh, and was originally designed for a commercial life; but his taste for natural philosophy led him to the construction of barometers and thermometers, and in this art he soon greatly distinguished himself. The use of quicksilver for filling the thermometer, which he introduced about the year 1720, was a very essential improvement in the accuracy of the instrument.

ON THE TEMPERATURE OF SEA,* &c.

TEMPERATURE OF THE SEA.†—"With respect to the temperature of the sea," says Bishop Watson, "at different depths, it seems reasonable enough to suppose, that in the summer time it will be hotter at the surface than at any considerable depth below it, and that in winter it will be colder."

Mr. Wales describes the instrument he made use of for trying the temperature of the sea, at different depths, in the following terms:—"The apparatus for trying the sea-water at different depths, consisted of a square wooden tube, of about 18 inches long, and three inches square externally. It was fitted with a valve at the bottom, and another at the top, and had a contrivance for suspending the thermometer exactly in the middle of it. When it was used it was fastened to the deep sea-line just above the lead, so that all the way it descended, the water had a free passage through it, by means of the valves, which were then both open; but the instant it began to be drawn up, both the valves closed by the pressure of the water, and of course the thermometer was brought up in a body of water of the same temperature with that it was let down to."—With this instrument, which is much the same with one formerly described by Mr. Boyle, in his observations about the saltness of the sea, water was fetched up from different depths, and its temperature accurately noticed in different seasons and latitudes.—August 27th, 1772, in latitude 24° 40′ south, the heat of the air was 72½°, of the water at the surface 70°, but at the depth of 80 fathoms it was 68°. Also in December 27th, 1772, in latitude 58° 24′ South, the heat of air was 31°, of the water of the surface 32°, but at depth of 160 fathoms 33½°.

In the voyage to the high northern latitudes before mentioned, they made use of a bottle to bring up water from the bottom, which is thus described:—"the bottle had a coating of wool, three inches thick, which was wrapped up in an oiled skin, and let into a leather purse, and the whole inclosed in a well pitched canvas bag, firmly tied to the mouth of the bottle, so that not a drop of water could penetrate to its surface. A bit of lead shaped like a cone, with its base downwards, and a cord fixed to its small end, was put in the bottle; and a piece of valve leather, with half a dozen slips of thin bladder, were strung on the cord, which, when pulled, effectually corked the bottle on the inside."——Here follow two of the experiments which were made during that voyage:

"August 4th, 1773, in latitude 80° 30′ North, the heat of the air was 32°, of the water at the surface 36°, of water fetched up from the depth of 60 fathoms under the ice 39°.——September 4th, 1773, in latitude 65° 0′ North, the heat of the air was 66½°, of the water at the surface 55°, of water from the depth of 683 fathoms 40°."

It therefore appears, from all these experiments, that when the atmosphere was hotter than the surface of the sea, the superficial water was hotter than at a great depth; and when the atmosphere was colder than the surface of the sea, it is evident that the superficial water was somewhat colder than at a considerable distance below it.

The Temperature of the Sea varies at different depths, but at great depths it is found to be nearly uniform. In winter, when the surface of the water is much cooled by contact with the colder air, the deeper and warmer water at the bottom, being impregnated with heat from various causes, rises and tempers the water upward to its surface; and as the cooler water constantly descends during the winter, in the following summer the surface is generally warmer than at any considerable depth; but in winter the surface is colder. As the sea in high latitudes is rendered heavier than in low and warm latitudes, hence a continual current from the Poles to the Equator occurs, which sometimes conveys down large masses of ice, which serve to cool the air to a great extent.

* For the result of a series of Hydro-Thermometrical Observations made in the Firth of Forth, Scotland, see Edinb. Phil Journal, No. Part 19, p. 189, &c.

† See an interesting paper from the MS. Journal of John Davy, M. D. F. R. S. on the Specific Gravity and Temperature of Sea Water, made during a voyage from Ceylon to England in 1819-20, published in the Edinb. Phil. Journal, No. 20, for April 1824.

These experiments will prove, that between the tropics, and in the temperate zones at sea, when the warmth of the temperature of the atmosphere exceeds that of the surface, the superficial water is generally warmer than that at certain depths beneath it; and, in all probability, the greater the depth, the colder the fluid in such case.

"On the 23d of February, in latitude 52° S. and about the longitude of 50° W.—Captain Krusenstern says, the temperature of the air was 12° Reaumer, of the surface 10°; and at the depth of 55 fathoms, 8¼°; the whole depth at the time being 75 fathoms.—On the 9th of March, in latitude 50° 20′ S. and longitude 72° 45′ W. the temperature of the air was 4° Reaumer; the surface 2¾°; at the depth of 60 fathoms, 2⅓°; and at 100 fathoms, 1¾°.—On the 24th of May, 56 miles south of the Equator, and in longitude 146° 16′ W. the temperature of the air and the surface were equal at 22¼°; and at the depth of 100 fathoms, 12¾°.—On the 22d of June, on the tropic of Cancer in the Pacific, the temperature of the surface of the sea was 20° 5′ Reaumer; at the depth of 25 fathoms, 19° 5′; at 50 fathoms, 17° 2′; and at 125 fathoms, 13° 3 min. so that there was here a progressive difference of temperature of 1 deg. at 25 fathoms, 3 deg. 3 min. at 50 fathoms, and 7 deg. 2 min. at 125 fathoms."

Many more examples might be given to the same effect if it were necessary. One very remarkable one is mentioned by Mr. Abel Clarke, in his recent work: he informs us, "that Captain Wauchope, of his Majesty's ship Eurydice, when within a few leagues of the Equator, during a calm, put his apparatus overboard, and allowed it to descend till it had run out 1400 fathoms of line; however, he estimated the perpendicular depth at only 1000 fathoms. The temperature of the surface was 73 deg. of Farenheit. On drawing up the instrument, he found the thermometer marking 42 deg. a difference of temperature of 21 deg." And there can be little doubt but that the difference of the temperature was progressive from the surface to that depth.

The Philosophers of the North assert also, "that in shallow seas the cold substratum of liquid is brought nearer to the surface;" but though this may in general be true, yet it is not to be relied on in particular cases, much less their assertion that "the increasing coldness of the water drawn up from the depth of only a few fathoms, indicates to the navigator who traverses the wide ocean his approach to banks or land." However, the judicious navigator is recommended to prove the accuracy of the above by experiment.

Some instances in proof of this may be collected from the journal of Captain Hall, of the Lyra, lately published, who made some experiments on the temperature of the sea at the surface, at the Loochoo islands, and in the Yellow Sea, &c.

"On the 19th of July, when off Chusan, in 32 fathoms water, the temperature of the surface of the sea was 78 and 80 degs. and on the 22d, in 43 fathoms, it was only 77 and 72 degs. but when at anchor in 3½ fathoms, in the gulf of Petchelee, in latitude 38 deg. 42 min. and longitude 117 deg. 49 min. W. on the 27th of July, the temperature of the surface was as high as 82 deg.—Also on the 3d of August, when at anchor off Peiho, the temperature of the surface was 82 deg. at noon, and 80 deg. at midnight, and there it was generally warmer than the atmosphere itself. When at anchor in Napakiang harbour, the general temperature of the surface of the sea was about 83 deg. but out at sea, off the island of Loochoo, when in latitude 26 deg. 36 min. and longitude 127 deg. 56 min. the surface was 4 or 5 degrees colder; being on the 14th and 15th only 79½ deg. and 78 min. Again, on the 20th of October, at anchor in Napakiang, when the autumnal cold had lowered the temperature of the sea's surface there to 75½ and 75 degs. (or 7 and 8 degrees below what it was when anchored there before), yet in the Japan Sea the surface was also lower, being 74 and 73 degs.

Thus in these particular instances the water became warmer (at least at the surface) the nearer the land was approached; and also as the depth of water decreased.

The mean height of the Thermometer at the Sandwich Isles is 80 deg. Farenheit.

Mr. Abel Clarke has also published the result of a few experiments made by him on the temperature of the sea in soundings both at the surface and bottom, which, though highly useful and satisfactory, are not conclusive. They are shown in the following

TABLE.

No.	Date. July 1816.	North Latitude.		East Longitude.		Depth—Fathoms.	Place.	Temperature.			Difference of Temperature.		
								Air.	Surface.	Bottom.	Of the air and surface.	Of the surface and bottom.	Of the air and bottom.
		Deg.	Min.	Deg.	Min.			°	°	°	°	°	°
1	23 8 A. M.	35	01	123	40	40	Open Sea.	76	74	65	2	9	11
2	24 noon.	36	24	122	59	15	do.	75	71	67	4	4	8
3	25 8 A. M.	37	30	122	40	20	do.	72	67	62	5	5	10
4	8 P. M.					15	do.	74	69	66	7	3	8
5	26 6 A. M.	37	58	121	34	15	Metau Isles.	74	67	66	7	1	8
6	27 11 P. M.	38	12	120	30	15	Gf. of Petchelee.	75	74	72	1	2	3

From these experiments (Mr. Clarke observes), it appears—1st, that the sea "diminishes in its warmth of temperature in proportion to its depth;" and 2d, "that the difference of the temperature of the surface, and any given depth within a a certain range, is greater at sea than near the land;" and 3d, "that the difference of the temperature at the surface and bottom is greatest, when that of the air and surface is least."

The first and third positions appear evident on the face of the experiments; but the experiment No. 3 seems to affect the correctness of the 2d position, for the difference of the surface at 20 fathoms depth was 5 deg.; and by that of the first experiment made farther from the land, there was a difference of 9 deg. only in 40 fathoms, which was proportionally less than near the land.

It is remarkable, however, that all these experiments (except the third) prove, as far as they go, that in the depth of 15 fathoms, the water at the bottom was invariably warmer than it was found to be at the depth of forty fathoms "in the open sea;" and in the Gulf of Petchelee, where the sixth experiment was made, it was no less than 7 deg. warmer at the depth of 15 fathoms.

The difference in the state of the atmosphere when the third experiment was made, seems to account for the alteration in the temperature of the water at the bottom, and its being so much below what it was found to be by the other experiments.

There is also a much larger proportional difference in the temperature of the air and water at the depth of 20 fathoms, than by the rest of the experiments.

The temperature of considerable depths of the Caribbean Sea:—Captain Sabine found the temperature of the water, at a depth of 6000 feet, in latitude 20¼ N. and longitude 83¼ W., near the junction of the Mexican and Caribbean seas, to be 45 deg. 5 min., that of the surface 83 deg. He infers, that 100 or 200 fathoms more line, would have caused the thermometer to descend into the water at its maximum of density as depends on heat; this inference being on the presumption that the greatest density of salt water occurs, as is the case in fresh water, at several degrees above its freezing point.

The following TABLE points out that it is not the month of April, as Kirwan affirms, that approaches nearest to the annual temperature.

Names of Places.	Mean Temperature.			Names of Places.	Mean Temperature.		
	Of the Year.	Of October.	Of April.		Of the Year.	Of October.	Of April.
Cairo . .	72° 3	72° 3	77° 9	Gottingen .	46° 9	47° 1	44° 4
Algiers .	69 8	72 1	62 6	Franeker	52 3	54 9	50 0
Natchez . .	65 0	68 4	66 4	Copenhagen .	45 7	48 7	41 0
Rome . .	60 4	62 1	55 4	Stockholm .	42 3	42 4	38 5
Milan . .	55 8	58 1	55 6	Christiana .	42 6	39 2	42 6
Cincinnati .	53 6	54 9	56 8	Upsal . .	41 7	43 3	39 7
Philadelphia .	53 4	54 0	53 6	Quebec . .	41 9	42 8	39 6
New York .	53 8	54 5	49 1	St. Petersburgh	38 8	39 0	37 0
Pekin . .	54 7	55 4	57 0	Abo . .	41 4	34 0	40 8
Buda . .	51 1	52 3	49 1	Drontheim .	39 9	39 2	34 3
London . .	51 8	52 3	49 8	Uleo . .	33 1	37 9	34 2
Paris . .	51 1	51 3	48 2	Umeo . .	33 3	37 8	34 0
Geneva . .	49 3	49 3	45 7	North Cape	32 0	32 0	30 2
Dublin . .	48 6	48 7	45 3	Enontekies .	27 0	27 5	26 6
Edinburgh .	47 8	48 2	46 9	Nain . .	26 4	33 1	27 5

As travellers are seldom able to make observations for giving immediately the temperature of the whole year, it is useful to know the constant ratios which exist in each system of climates, between the vernal and autumnal temperatures, and the annual temperature.—See M. Humboldt on Isothermal Lines, and the Distribution of Heat over the Globe.

Experiments made by his Excellency Sir Thomas Brisbane, K. C. B. F. R. S. London and Edinburgh, &c. in November and December 1822, which correspond to May and June of our climate:

"In the most elevated ground in the neighbourhood of Paramatta, New South Wales Australia, a cylindrical hole was bored in the earth, about 3¼ inches in diameter, and passing through clay and rotten sand-stone. The mean of all the temperatures, at depths varying from 6 to 24 feet, was 61 deg. 9 in the air, and 62 deg. 9 in the water. This excess of heat in the water no doubt arose from its having descended from the strata nearer the surface.

"In another set of experiments, made in above 12 feet deep, the mean temperature was 60 deg. 4 in the air, and the very same in the winter.

"In a third series of observations on the temperature of wells and springs, made in the same months, the mean temperature of a pump-well, 20 feet deep, was 61 deg. and that of a spring at the surface 61 deg. 5.

"The mean of all these results for the mean temperature of the earth at Paramatta, in November and December, and probably for the whole year, is 61 deg. 5, whereas the mean temperature of the atmosphere, as calculated by Dr. Brewster's formulæ, is about 63 deg. This difference of 1½ deg. is nearly the same that exists between the temperature of the earth and the temperature of the atmosphere in corresponding latitudes in the northern hemisphere."

Expressly intended for Thermometrical Experiments.

The ingenious Mr. Jamieson has invented a case of the following description:—The case is a tube made of copper, the length of which tube is about 18 inches by 2 inches diameter; the lid is about 2 inches deep, and has a check to fit the tube, and it has a conical or puppet valve in it, made to rise upward; at the lower end of the tube is another valve of the same description, also made to rise upward; these two valves permit the water to pass freely through the tube while it descends in the water; but, so soon as it stops, the valves shut, and, the water admitted, at the greatest depth to which the machine is sunk, remains in the tube, around the thermometer.

Directions for using the Marine Thermometer Case.

A stout line of some fathoms in length should be made fast to the handle of the case, which may be carried forward and hove like the deep sea-lead. The length to be passed forward will depend on the velocity with which the vessel, on board of which it is used, moves through the water; but a few experiments will inform the observer what length of time is proper to allow the mercury to rise or fall sufficiently, for the purpose of indicating the true temperature of the sea. The observer must then haul up the case by the line, open the lid, and draw out the thermometer a sufficient length to allow of the altitude being read off, as pointed out by the mercury in the thermometer tube; but, in doing this, care must be taken always to keep the bulb of the thermometer immersed in the water contained in the case.

In practice, the case ought to be sunk as perpendicularly as possible, in order to ensure a free passage of water through it; and care must also be taken never to permit the case to touch the bottom, as sand or other substances might get within, and render the lower valve of no use till cleaned.

The depth to which the instrument should be sunk will depend on various circumstances; however, a few fathoms will generally be sufficient. Probably to sink the thermometer a foot or two lower than the ship's keel would be sufficient; but, attentive observers will seldom fail to try it both at greater and lesser depths.

The frequent use of the thermometer is earnestly recommended; and it may be interesting, at the time when the observations are made on the heat of the sea, to note corresponding ones of the temperature of the air.

Remarks by Colonel Williams on the use of the Thermometer at Sea, intended to accompany Jamieson's Marine Thermometer Cases.

An important point would be to observe the heat of the water in different places, and then compare them with another, i. e. in or near the stream, in the ocean, out of the stream, on the coast, and near islands of ice. But it is not so necessary to observe the difference between the heat of the water and the air at different places as some persons have imagined.

From April 28, at 10 a. m. to April 29, at 8 a. m. the temperature of the sea on the shoals of Sable is from 40 to 43. At 5 p. m. the warm influence of the Gulf Stream is found generally from 62 to 64. At 10 p. m. the temperature between the influence of the stream in deep water and the coast is found at 54 deg. which is about a mean between the two; then standing off shore, at 9 the next morning, 30th, the warm influence of the stream was again experienced.

If these differences of temperature in the water had been distinguished by the colours of white, red, and blue, they could not be more apparent than they were by a judicious use of the thermometer.

About 23 hours afterwards (May 1st, at 8 a. m.), the water cooled, and, in three hours more, the mercury fell 14 deg. 46 min. Here no bottom could be found, and there was probably an island of ice near us, obscured by fog. (For the coldness of ice condenses the atmosphere, and the consequence must be fog.) Passing this at two p. m. the thermometer rose to 54 deg. but in one hour more it fell to 46 deg. again, and an island of ice appeared at the distance of seven miles. Let navigators reflect on this, and agree that a sudden fall of six degrees, in this part of the ocean, ought to induce them to haul to the southward, and keep a good look-out. From May 1, at 11 a. m. to the next morning at one a. m. the gradual changes as the ship passed the ice took place, and we came again into ocean water (50 deg.) but in two hours more, the ship was in the warm influence of the stream again, and the mercury rises 10 deg. (60 degs.) She proceeds in a nearly regular degree of heat during 17 hours; till, at 6 p. m. the water begins again to cool, falling at 56 deg. at midnight. Here was no bottom in 80 fathoms. May 3, at 4 a. m. the water was at 43 deg. still no bottom in 80 fathoms. Now, from past experience, we may say, there was an island of ice in a less distance than 7 miles, because at that distance the water was at 46 deg. When day appeared, behold an enormous island of ice 100 yards abreast, and the heat of the water reduced to 39 deg. Had not the thermometer been thus used, had it not been continued during the night, what would have been the fate of this ship? Let the recollection of the miserable fate of the ship Jupiter be impressive! and let it be given as a maritime rule, that want of caution, or ignorance, alone, can occasion such accidents in future.

(Signed) JONA. WILLIAMS.

The Captain's protest, containing the particulars, of the distressing circumstance of the ship Jupiter, states—"April 6, in latitude 44 deg. 20, longitude 49 deg. at 8 a. m. observed several pieces of broken ice, from which, at 11 the same day, we supposed ourselves entirely clear, and steering W. by N., West, E. NE. with foggy weather. At two p. m. began to discover islands of ice, and at 3 o'clock saw a large field of ice a-head, which appeared to have no opening. We then wore ship, and kept off to the southward and eastward; continually passing small islands of ice, until 5 p. m. when we found the ice extending so far to north and south, that we could not clear it. We then hove about, and stretched to the northward, among the broken ice, till night came on, and perceived no prospect of getting clear. We hove-to under the three topsails double reefed, in hopes to have sufficient drift to keep clear of the fields of ice to leeward until daylight; but found, at about 11, we were drifting fast upon a large field, and were obliged to wear ship, and haul to the southward under easy sail, luffing and bearing away from the broken ice as occasion required, until half-past twelve, when we struck against it, and a small piece of ice went through the starboard bow."

Heights of the Thermometer according to various Baths, &c.—Hot House Plants—Botanical Purposes—and Green House Plants.

Great care should be taken in purchasing Thermometers of persons of respectability, as they can truly warrant them, divided in an accurate manner. This caution becomes necessary, as some persons have exposed thermometers for sale with new tubes placed against old divisions. Were an improper thermometer to be employed for ascertaining the heat of a human bath, the consequences might prove fatal to the bathers.

For the Baths, &c.

116	King's at Bath, or hot pump at Bath
114	King's Bath at Bath
109	Cross Bath at Bath
104	Common at Bath
82	Buxton Bath
76	Bristol hot well, or Bristol pump
68	Matlock's Bath
48	Common Spring
43	Common Water.

For Hot House Plants.

75	Pine Apple
74	Cinnamon
73½	Mel. Thistle
72½	Coffee
72	Piamento
71	Tamerind
70	Euphorbium
69½	Cereus
67½	Cassia
67	Aloes
66	Indian Fig
65	Capers
64	China Rose
63	Cape Jasmin
61½	Jacobus Lilly
60½	Canna
59¼	Solanum
58	Ranum Arum.

For Botanical Purposes.

76	Cinnamon
74	Rhubarb
73	Mel. Thistle
72	Pine Apples
70	Grapes
68	Coffee
67	Piamento
65	Tamerind
64	Euphorbium
62	Ginger
60	Cereus
58	Cassia
57	Aloes
56	Pomegranate
54	Indian Fig
52	Capers
51	Ficoides
49	Olives
48	Oranges
46	Lilies
44	Myrtles.

For Green House Plants.

55	Ficoides
53½	Cyclamen
52	Geraniums
51	Narturtium
49½	Cacalia
48	Pomegranate
47	Olives
45½	Oranges
44	Barba Jovis
43	Persian Jessamin
41½	Sedum
40	Myrtles.

A List of the result of Experiments already made with a Thermometer divided according to the divisions of Farenheits Scale Barometer, in many cases standing at about 29 inches.

600 Quicksilver, called by the chemists mercury, boils—550 Oil of turpentine boils—546 Oil of vitriol boils—540 Lead melts—408 Tin melts—290 Mineral tallow boils*—242 Spirit of nitre boils—240 Lixivium of Tartar boils—213 Cow's milk boils—212 Fresh water boils—206 Human urine boils—190 Brandy boils—176 Spirits boil—175 Alcohol or spirits of wine boils—150 Serum of blood and the white of eggs harden—146 this heat kills various animals in a few minutes—118 Mineral tallow melts—112 Fever heat—108 to 99 Hens hatch eggs—107 to 103 Heat of the skin in ducks, geese, hens, pigeons, partridges, and swallows—106 Heat of the skin in common ague and fever—103 to 100 Heat of the skin in dogs, cats, sheep, oxen, swine, and most other quadrupeds—99 to 75 Heat of the human skin in health—98 Blood heat—97 Heat of a swarm of bees—96 A perch died in five minutes—95 Butter begins to melt—90 Greatest heat of the sea in the Gulf of Mexico—86 to 100 Extreme heat of the summer—86 Heat of the sea in the Gulf of Florida—83 Heat of the air in the shade in very hot weather in Great Britain—82 Common heat of the Sea near the equator—76 Summer heat—65 to 58 General temperature of the air at midsummer in Great Britain—64 Heat of air in the shade in warm weather in ditto—60 the temperature for ascertaining the absolute weight and specific gravity of gases (barometer at 29.8).—41.5 to 60 temperature of the Lake at Thun in Switzerland—41 to 58 Temperature of the Lake Zug in ditto—55 Mean temperature of the air in England—43 Oil of olives begin to stiffen or to become opaque—26 to 42 General temperature of the air in winter in Great Britain—32 Water just freezing, or snow and ice just melting—30 Milk (from cow) freezes—28 Common vinegar freezes—25 to 27 blood out of the body freezes—15 to 25 Temperature of the air in severe cold weather in Great Britain—20 Burgundy, Claret, and Madeira wines freeze—5 Great cold in Pennsylvania in 1731, latitude 40 N.—4 Greatest cold at Utrecht in 1728 and 1729—0 A mixture of snow and salt, which is able to freeze oil of tartar per deliquium, but not brandy—39 below 0 Quicksilver or mercury freezes.

Indications of Rain, as ascertained in Summer time by the movement of various Animals, &c.

Swallows fly low. Dogs grow sleepy and eat grass. Water fowls dive much. Fish usually caught by angling will not bite. Toads crawl about. Moles are very busy and cast up more earth than usual. Ants are very active, and bees stir not from their hives. Flies become very troublesome. Ducks and geese picking their wings, washing themselves much, or making much noise. The swine are restless. The cricket sings sharp. Cats wipe their wiskers. The glow-worms are numerous and bright. The blackbird's voice is shrill. The peacocks cry. Earth-worms creep out of the ground. Gnats flying up and down in the open air, near sun-set, foretell heat; if in the shade, warm and mild showers; but if they join in stinging those persons who pass them cold weather and much rain may be expected. The eel, though it lives in an element that seems to place it beyond the reach of atmospheric changes, is yet singularly affected by high winds, especially from the westward.

WEATHER.—*The state or disposition of the Atmosphere with regard to Heat and Cold, Dryness and Moisture, Wind, Rain, &c.*

It is worthy of remark, that the heat of the summer 1818 was considered general from the north to the south of Europe. The thermometer indicated a longer continuance of heat than had been experienced during the last forty years. The effect of this heat on the vegetable and animal world must have been prodigious, and was more extensive than we have any idea of.

It is a singular coincidence, that in 1718, which is one hundred years from the above date, the weather was extremely hot and dry all over Europe. The heat was so oppressive, that at Paris all the theatres were closed, and scarcely any rain fell for the space of nine months. The springs and rivers were dried up; the grass and corn were quite parched. However, in some places the fruit-trees blossomed two or three times, and the thermometer (Fahrenheit) rose to 98°.

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* Mineral tallow discovered in Finland in 1736. Found in 1824 on the borders of Loch Fye in Scotland.

The United States of America appear to have suffered from intense heat equally with Europe in the year 1818, for a New York paper of the 14th of July says,—"The thermometer during the last two days indicated a greater degree of heat than had been experienced, we believe, for the last eight or ten years. At three o'clock on Saturday the mercury in the shade stood at 93°, and at the same hour on Sunday at 96°."

The thermometer in the city of Philadelphia, in July 1818, stood at 102°, average 100, and it is stated four or five persons died by having imprudently drank cold water,* notwithstanding the frequent cautions that had been given.

For extreme heat at Bagdad, Aug. 25, 1819, see Edin. Phil. Jour. No. 5. p. 197.

A perpetual Table for Foretelling the Weather through all the Lunations of each Year.

This Table and the accompanying remarks, are the result of many years actual observation; the whole being constructed on a due consideration of the attraction of the sun and moon in their several positions respecting the earth; and will, by simple inspection, show the observer what kind of weather will most probably follow the entrance of the moon into any of her quarters, and has been seldom found to fail.

Moon.	Time of Change.	In Summer.	In Winter.
If the New Moon—the First Quarter,—the Full Moon,—or the last Quarter, happens	Between Midnight and two in the morning	Fair	Hard Frost, unless the wind be S. or S.W.
	—— 2 and 4 Morn.	Cold and Showery	Snow and Stormy.
	—— 4 and 6 ——	Rain	Rain, Sleet, or Snow.
	—— 6 and 8 ——	Windy and Rain	Stormy.
	—— 8 and 10 ——	Changeable	Cold Rain, if wind W. Snow, if E.
	—— 10 and 12 ——	Frequent Showers	Cold with high wind.
	At Twelve o'clock at noon and Two p.m.	Much Wet	Snow or Rain.
	Between 2 and 4 Aftern.	Changeable	Fair and Mild.
	—— 4 and 6 ——	Fair	Fair.
	—— 6 and 8 ——	Fair, if wind N.W. Rainy, if S. or S.W.	Fair and Frosty, if wind N. or N.E. Rain or Snow, if S. or S.W.
	—— 8 and 10 ——	Ditto	Ditto.
	—— 10 and Midnight	Fair	Fair and Frosty.

OBSERVATIONS.—The closer the first quarter, full, or last quarter, is to midnight, when the moon changes, the more favourable will the weather be during the seven succeeding days.—The nearer to mid-day that these changes of the moon take place, the more unfavourable the weather will prove during the seven days following.

For a monthly Meteorological Table, see an interesting work, entitled, "The London Journal of Arts and Sciences," by W. Newton Esq.

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* A man at New York, after drinking cold water, was seized with symptoms the most alarming. However, half an ounce of camphor, dissolved in a gill of brandy, and divided into three parts, one of which was given at intervals of three minutes, soon gave the patient relief.

ATMOSPHERICAL PHENOMENA, &c.

ATMOSPHERE.—This is according to some writers, the air encompassing the solid earth—probably it may be styled that whole mass of fluid which combines air, aqueous and other vapours, mixed with electric fluid, &c. It surrounds the earth to a considerable height; the atmosphere is proved to be a mixed fluid, 13 cubic feet of which weigh one pound avoirdupois, and one cubic foot of which weighs 1¼ oz.; its specific gravity to water is as 800 to 1 nearly; the proportions, qualities, and effects, are so numerous and so various, that it would be difficult to define them with any sort of precision. One of its most essential properties is its power of preserving life in all animated beings, sustaining the vegetable world, &c.

The various temperature of the atmosphere is owing to a variety of causes chiefly unknown. All the following affect it more or less at times. It is reasonable to conclude, that winds flowing from cold countries will produce cold in other parts, and the contrary when they blow from hot countries; and that such winds must occasion unusual cold or heat in those parts of the world where it is most felt.

Water always absorbs a quantity of heat, particularly when in a state of vapour; hence the coldness of marshy countries, and also that which we often experience during and after violent rains. Hence also we may expect, after a cold winter a rainy summer, because the exuberant evaporation effected by it will carry off the superfluous moisture of the earth upward.

VAPOURS.—Any thing exhaling and mixing with the air is termed a vapour. Vapour is considered an elastic invisible fluid, like common air. The air when condensed, being acted upon by heat, gives out a quantity of it; a country, therefore may become heated by a condensation of vapour over it, though brought perhaps from a considerable distance. This may account for a certain sultryness often felt before the commencement of rain. Vapours, when these remain for a long space of time over any country, will often occasion much cold, and this by obstructing the passage of the sun's rays from operating on the earth. This effect of vapour is given as a reason for the very severe winter of 1784. After a severe winter, considerable quantities of ice accumulate about the North Pole, which frequently contribute towards lowering the temperatuie of several succeeding years.

EVAPORATION.—The act of passing off in fumes or vapour, also the act of attenuating matter so as to make it fume away. Evaporation is produced by combination of caloric with particles of water, by which it becomes connected into an elastic fluid much lighter than air, which therefore immediately ascends and mixes with the atmosphere.

QUICKSILVER, OR MERCURIAL VAPOUR.—M. Billiet observes, that for a long time past it has been known that during hot seasons mercurial vapour formed spontaneously in the upper part of the barometer tube. Quicksilver is a naturally fluid mineral, and the heaviest of all known bodies next to gold, and is the more heavy and fluid as it is most pure. It is wholly volatile in the fire, and may be driven up in vapour by a degree of heat very little greater than that of boiling water.

RAIN.—The superfluous moisture with which the clouds are charged, or the water that descends through a part of the atmosphere in the form of globules, or drops of various dimensions. Whatever suddenly disturbs the heat or density of the air, or the electrical power contained in the clouds, occasions the particles of vapours to rush together, and form drops of water too heavy to continue suspended in the atmosphere. They then sink, increase in their descent, partaking of various floating vapours through which they pass, and then descend in what is called rain.

Previously to rain very different appearances are frequently observable in and about the atmosphere. The cumulus in the lower atmosphere becomes altered in appearance, for instance, denser, irregular, and rock like in its superstructure, with fleecy protuberances near its base, ultimately forming a complete cumulo stratus.

More rain falls in mountainous countries than in plains. In England it generally rains less in March than in November, in the proportion at a medium of 7 to 12. It generally rains less in April than October, in the proportion of 1 to 2 nearly at a medium. It generally rains less in May than September, the chances that it does so are at least 4 to 3, but when it rains plentifully in May (as 1.8 inches or more), it generally rains but little in September; and when it rains 1 inch or less in May it rains plentifully in September.

RAINBOW.—The semicircle of various colours which appears in showery weather. It is said that a rainbow in the morning is the shepherd's warning, but one at night is his delight.

LUNAR RAINBOW.—This phenomenon is of rare occurrence. However, a gentleman on the 7th Oct. 1824, when entering the town of Arras in France, about eight o'clock in the evening, saw one as vivid and distinct in colours, and as perfect in the segment of the circle which it formed as almost any solar rainbow he ever saw. There was also a second one fainter, as if it were the shadow or reflection of the other. This splendid meteor was produced on a thick rainy cloud, which passed over him. The moon at this time might be, to the best of his recollection, at an elevation of 45 degrees from the horizon.

SQUALLS.—Are sudden gusts of wind, &c. Squalls are transitory gusts of wind caused by adjoining portions of the atmosphere becoming suddenly unequally rarified or condensed, which is probably often effected by the mere intervention of opaque or dark clouds, obstructing the equal diffusion of the sun's rays on the atmosphere. The thunder, lightning, and heavy rain, however, which usually accompany squalls within the tropics (where they are by far most frequent), prove them to be principally caused by the active power of electricity.

WHIRLWIND.—This is a strong stormy wind, moving first horizontally, and then proceeding upward in a spiral form. The meeting of winds often produce a whirlwind, by which a cloud placed between them is sometimes compressed into the shape of a cone, such winds whirl round it with very great rapidity, exerting all its vortical power. Some whirlwinds are slow in their movements, and are injurious only by their vortical or whirling motion; others do mischief by whirling and proceeding at the same time—the latter are termed typhoons. They follow the course of rivers, an instance of which occurred at Charleston, South Carolina, on June 1, 1761: at about fifty miles W. by S. of Charleston, about the middle of the day, the typhoon was first noticed, and it destroyed a number of houses, &c. It made avenues through the woods and other places; every tree and shrub was torn up in its career; its course was directed down Ashley River, on which it moved with tremendous rapidity. Its appearance was that of a column of vapour or smoke, the motion of which was as irregular as it was noisy; its force was so great that it turned Ashley River up from the bottom, laying part of its channel bare, and proceeding onward with a tumultuous noise. However, at White Point it was met by another typhoon from Cooper's River. It appeared of inferior force, but on their mixing together the agitation of the air was considerably increased. It next assailed the shipping in the road, some of which it destroyed It is computed that it was not more than four minutes in its passage, although the distance is estimated at seven miles. The damage sustained amounted to about 20,000*l.* and had it not been for the gust which fortunately came down Cooper's River, Charleston in all probability would have been nearly destroyed.

The singular effects of a whirlwind were visible in June 1824 in the neighbourhood of London: About one o'clock in the day, in a brick-field at Brompton, in the possession of Mr. Blake, a short distance from Gloucester Lodge, a sudden roar of wind was heard by the workmen, and the straw which covered a long row of unburnt bricks was in a moment carried up in the air to a prodigious height, when in separate masses, it presented the appearance of a detachment of balloons; these aeronauts of straw took a southerly direction, and remained in sight a quarter of an hour. The state of the air previously to the phenomenon was quite calm.

PERTH, 2d Nov. 1824.—About four o'clock on Tuesday afternoon, a concussion of air, not unlike the violence of a tropical tornado, was experienced in this neighbourhood. The wind arose suddenly, and with such force, that many houses in the country; within a few miles of this city, were unroofed, and the windows driven in. A considerable quantity of cloth was carried up by the whirlwind from Luncarty Bleachfield, part of which was recovered from the east side of the Tay. At Leach Hill a pea-stack was carried away, and not a vestige of it has been seen. Several trees at Craigie were torn up by the roots, and six of the large willows at the top of South Inch were stripped of their branches, and their trunks rent and broken.

HURRICANE,—This is a strong and violent storm, often experienced in the western hemisphere. "Some tracts of the torrid zone are subject to periodical and irregular storms, the violence of which much exceeds the greatest tempest ever yet experienced in the temperate zones. The hurricanes of the West Indies and Indian Sea, and the typhoons of the China Sea, are of this description. In the hurricane the elements seem to combine for the destruction of nature; forked lightnings cross each other incessantly in every direction, the thunder roars without intermission; the rain is precipitated in torrents; the sea, driven forward and upward, is forced with irresistible fury towards the land, while the winds, blowing at once from the various points of the horizon, sweep away things of such magnitude as would astonish those who have never witnessed its destructive effects; for it has been known to scoop out and remove large portions of the earth to an almost incredible distance.

TORNADO.—Is a violent squall or gust of wind rising suddenly from the shore, and afterwards veering round the compass like a hurricane. They are most frequent on the coast of Guinea and S. W. coast of Barbary.

HAIL.—Consists of vapours united into drops of rain, and being frozen while in a state of falling, they assume various figures; round, pyramidal, cuniated, angular, thin and flat, and sometimes stellated with six radii, like the small crystals of snow. Hailstones have sometimes been found of an extraordinary magnitude. See an account of a remarkable hailstorm in August 1813, by R. S. Stewart, Esq. in Phil. Trans. No. 17, page 194.

FROST.—Such a state of the atmosphere as causes the congelation or freezing of water, or other fluids, into ice. In the more northern parts of the world even solid bodies are affected by frost, though this is only or chiefly in consequence of the moisture they contain, which being frozen into ice, and so expanding, as water is known to do when frozen, it bursts and rends any thing in which it is contained, as plants, trees, stones, and large rocks. Many fluids expand by frost, as water, which expands about the one-tenth part, for which reason ice floats in water; but others again contract, as quicksilver, and thence frozen quicksilver sinks in the fluid metal.

Years.	
220	Frost in Britain that lasted 5 months
250	The Thames frozen 9 weeks
291	Most rivers in Britain frozen 6 weeks
369	Severe frost in Scotland for 14 ditto
508	The rivers in Britain frozen 2 months
558	The Danube quite frozen over
695	The Thames frozen 6 weeks, and booths built thereon
827	Frost in England 9 weeks
859	Carriages used on the Adriatic Sea
908	Most rivers in England frozen 2 months.
923	The Thames frozen 13 weeks
987	Frost lasted 120 days, began 22d Dec.
991	The Thames frozen 5 weeks
1035	Severe frost June 4; the corn and fruits destroyed
1063	The Thames frozen 14 weeks
1076	Frost in England from Nov. to April
1114	Several wooden bridges carried away by the ice
1407	Frost lasted 16 weeks
1434	Frost from Nov. till February.—The Thames frozen to Gravesend
1603	Frost for 13 weeks
1739	A ditto which lasted 9 weeks, began Dec. 14.
1747	Severe frost in Russia
1760	Severe ditto in Germany
1778	Thames frozen below bridge; booths upon it
1793	Severe frost in England
1814	Intense frost.—The Thames frozen, and all sorts of amusements on it.

On the cause of regular figures formed by Hoar-frost on windows:

"This curious phenomenon was ascribed by M. Maïran to the pre-existence in the glass of certain regular figures and lines generated during its formation, and he supposes that the particles of hoar-frost deposit themselves according to these figures. M. Carena, in a Memoir Sur le Givre Figurèe, published in the Memoirs de Turin for 1813 and 1814, p. 56-79, has overturned this hypothesis, and shows that the following are among the principal causes of this phenomenon.

I.—The natural form of crystallization.

II.—The necessity of hoar-frost extending itself along a plane surface, which restrains the quaquauersus tendency of crystallization.

III.—The numerous and varied resistances presented by the surface of the glass.

IV.—The imperfect and irregular conducting power of the glass, which is apt to produce in the vapours curvilineal motions at the instant preceding their congelation. M. Carena placed a small copper disc on the outside of one of the panes of glass, and found that the corresponding part of the glass was always free from hoar-frost."

SNOW.—The several particles of water frozen before they unite into drops. Snow is a meteor formed in the middle region of the air of vapour, raised by the action of the sun on the earth and sea, or subassisted by the evaporation of subterraneous fires therein congealed, in parts constipated or condensed, its specific gravity increased, and thus returned to the earth in flakes of various sizes. The snow so well known is with great propriety ascribed to the coldness of the atmosphere through which it falls. When the atmosphere is warm enough to dissolve the snow before it reaches the earth it is termed rain. Should it, however, reach the earth undissolved, it makes what is called snow. Snow is evidently formed by a regular process of crystallization among minute frozen particles of water, while floating in the air, previous to and during the fall of snow (the structure of a crystal of snow demonstrates that a drop of rain is also formed by the union of a great number of smaller drops), the temperature continues about 32 deg. Far.—However, when flakes of snow are frozen, they become as firm as ice. Snow is a bad conductor of heat, and cold penetrates it with difficulty. Snow keeps plants which it covers, and has a peculiar property of preserving them from the influence of cold. It supplies them with continued moisture, preserves a great number from perishing, and still more from languishing, and consequently imparts a nourishment and protection which enables them to shoot out with strength and vigour.—For remarkable balls of snow at Brunswick, see Edin. Phil. Jour. Part 18, p. 397. Snow fell to the depth of 9 inches at Ashtabula, Ohio, U. S. on 29th Sept. 1824.

SLEET.—The drops of rain, accompanied with flakes of snow, altered by the mixing of the atmosphere with them, is called sleet.

DEW.—Is a vapour often condensed into visible drops. When the air is unable to hold a certain quantity of water in solution, the result is a deposition of it in aqueous particles. During the heat of the day a great quantity of vapour is drawn up into the atmosphere; in the evening, should the vapour not have been carried off by currents, &c. it will happen sometimes that more vapour remains diffused in the atmosphere than the temperature of the night can permit to subsist under the existing pressure of the aqueous atmosphere; therefore a decomposition of the latter takes place, which is continued until the existing temperature and aqueous pressure have attained an equilibrium. However, on the return of the sun, this process terminates. If the dew lies plentifully on the grass after a fine day, it is a sign of another fair day. If not, and there be no wind, rain must follow.

FOG OR MIST.—Consists of condensed vapours floating near the surface of the earth or sea. Five or six fogs successively drawn up portend rain.

MISTS.—A white mist appearing in an evening over a meadow, through or contiguous to which a river passes, will be drawn up the next morning, and the day may be expected to be clear and bright.

Where there are high hills, and a mist, which was perceived on the lower lands, draws to the hills in the morning, rolling onward until it reaches their summits, in such case there is good reason to conclude that the weather will be fair. But when the mist is about to leave the hills it is moved in a dragging manner along the woods, rain will shortly follow.

It is somewhat remarkable, that an intense fog will come on almost suddenly on the coast round the Shetland Isles.—These islands are situated to the north of Scotland.

MIST* AND DEW.—For the formation of mist, it is necessary that the temperature of the water should be greater than that of the air; but for the deposition of dew, that the heat of the body on which it is to be deposited, should be less than that of the atmosphere. The deposition of dew must always precede the formation of mist. This will appear evident, when we consider the principles to which each owes its origin.—Suppose at some moment an equality of temperature to take place between the water, the land, and the volumes of air reposing over each. In consequence of the unequal cooling powers of the land and water, the former will first have its temperature reduced below that of the air; and although by this diminution the equality of temperature between the two volumes of air will be destroyed, and a condition created favourable to the formation of mist; still, as the cooling of the first volume, and the mingling of the two are not cotemporaneous acts, dew will be deposited first.

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* See a very interesting paper on Experimental Enquiries relative to the formation of Mists, by George Harvey, Esq. Roy. Quart. Jour. No. 29, page 55, and by Sir H. Davy, Edin. Jour. No. 3, p. 185.

HAZY.—That state of the weather which appears much like a fog, yet differs from it, as in foggy weather the atmosphere is dense and moist, but in hazy weather the air is more dry.

WATERSPOUT.—Amongst the atmospheric phenomenon observed at sea, the waterspout often attracts the attention of the seaman, but more particularly in navigating between the Tropics. When this spout is perceived forming, it gradually increases in length, until it seems to touch the horizon; it assumes the shape of a speaking trumpet, with the small end downwards. It always descends from a dense cloud, in a perpendicular direction, and when it touches the sea a sort of agitation takes place, and white vapour or steam is then perceptible. See also Edin. Phil. Jour. No. 9, p. 39.

Waterspouts are generally of a dark colour, but the upper part is the darkest. Its sides appear sometimes perfectly smooth. It begins to waste from the lower end gradually upward to the dense cloud, on its reaching which a heavy rain ensues. A moderate wind usually prevails during the appearance of this phenomenon, with a serene sky, excepting about that part from which the water spout commences.

On 26th August 1823, about three o'clock, a remarkable waterspout was seen in France, and a storm came on from the SW. accompanied with a sudden and powerful heat.

Sometimes a waterspout begins to form, but not receiving a sufficient supply of matter it soon disperses.

WHIRLPOOL.—(A place where the water moves circularly, and draws whatever comes within the circle towards its centre; a vortex.)—When two opposite currents of equal force meet, they form a spiral vortex, or whirlpool, of which the most celebrated are the Mael Stöm, on the coast of Norway, and Euripus, in the Strait of Negropont. Charybetis, in the Strait of Messina, has also been described as a whirlpool, though it seems to be only a violent agitation of the waters at the surface by the making of tides, and has no vortex.

PHENOMENA—sometimes observable about the Sun, Moon, and Stars. The sun's brightness frequently becomes obscured by a certain haziness in the air; it then causes this orb to appear whitish, and sometimes ill defined. At night, if the moon and stars should appear dimly, and a ring or halo encircle the former, rain will follow; if the sun's rays appear like Moses's horns, if white at setting, or shorn of his rays, or should he set in banks of clouds formed in the horizon, unpleasant weather may be expected. If the moon appears pale and dim we may expect rain; if red, wind; but when she is her natural colour, in a clear sky, fair weather will mostly prevail. If during one quarter the moon should prove rainy, it will most likely clear at its change, but probably the rain may recommence in a few days. Should the weather prove fair for the space of any one quarter, and rain commence at the change, fair weather may be expected on the fourth or fifth days next following. Shooting stars are supposed to indicate wind.

HALO.—Is a red circle round the sun or moon. A halo is an extensive luminous ring, including a circular area, in the centre of which the sun or moon appears, whose light passing through an intervening cloud gives rise to the phenomenon. Those about the moon are much commoner.—See also the Edin. Phil. Jour. No. 16. p. 394.

MOCK SUNS.—At Dalmellington, about mid-day, on March 25, 1823, the appearance of four suns were observed in the firmament at one time. An uncommon vivid halo, resembling a rainbow, half circled each of the mock suns, while the natural one was entirely surrounded. The appearance of the whole was extremely beautiful, and exceeded, in brilliancy and splendour, any thing of a similar nature which has occurred in the memory of the oldest shepherds in that quarter. This phenomenon, though varied in appearance, was likewise visible at Ayr.

CARONA.—When the sun or moon is seen through a thin cloud, a portion of the cloud more immediately round the sun or moon appears lighter than the rest of it; this luminous disc is called Carona. They are of various sizes; however, they seldom exceed 10 deg. in diameter. They are generally faintly coloured at their edges, frequently when there is a halo encircling the moon.

PARHELION—Is a Mock Sun. Sussex, 31st Aug. 1822.—A most beautiful parhelion, or mock sun, was observed a short time ago. A cloud of the cirro stratus kind was at the time passing before the sun. There was no halo or carona, but the colours of the rainbow singularly distinct and brilliant, and continued visible for about twenty minutes.

Gosport, May 26, 1823.

PARASELENE.—From eight till ten o'clock p. m. on 23d of May, two paraselenæ appeared alternately, one on the east side of, and both about the same altitude from the horizon as that of the moon. The eastern paraselene was the brightest; it had colours more vivid about it, and continued in sight some time after the other was extinct, perhaps from being on the side of the moon that was most vaporous. No stationary cloud was visible in or near either of them; but a light red carona, one degree in diameter, surrounded the moon nearly the whole time of their continuance, which indicated the pressure of haze, or lofty attenuated cirro stratus, that in some measure obstructed the lunar light. At a quarter past nine o'clock, these rare phenomena exhibited trains of light that were turned from the moon, and terminated in points or conical shapes; the eastern one was 12 degrees in length, and the western about seven. At a quarter before ten o'clock both the paraselenæ appeared in circular forms at the same time, without trains, and were tinged with light red, light yellow, and pea-green; at this time also, a faint lunar halo presented itself, and measured upwards of 44 deg. in diameter, when each of the paraselene just without the halo was 22 deg. 40 min. distant from the moon's centre. By half past ten the sky was completely overcast with cumulo stratus clouds, and light rain fell towards the morning. These were the finest and the most brilliant mock moons we have ever noticed. They are formed on the same principles as parhelia, and like them indicate a humid air and approaching wet, particularly when accompanied by the halo.

William Burney.

The phenomena of the Paraselene, Parhelia, the several kinds of Halo or Carona, all appear to result from the intervention of clouds that pass between the spectator and sun or moon.

METEORS—Are any bodies in the air or sky that are of a flux and transitory nature. Meteors or fire-balls have in all ages and climates been observed at times to traverse the higher regions of the air, and many of them have been described from ocular demonstration. One was observed on the 18th of August, 1783, about nine in the evening, when a meteor, exceedingly large and brilliant, passed over England, and a considerable portion of the continent of Europe, illuminating every place over which its tract lay, with an awful grandeur that astonished every beholder; its motion was amazingly rapid, and from observations made upon it in different places, it is computed that its diameter was little less than 3-4ths of a mile, and its altitude above the terrestrial surface at least 60 miles.

The motion of these meteors is, in general, accompanied with a hissing noise, resembling that of a shell projected from a piece of ordnance, and at their exit explosion takes place like that of a clap of thunder. This is usually attended by the fall of several stones of different magnitudes; many of them continue luminous and warm until they reach the surface, and bearing evident signs of recent fusion. They often fall with so great a force as to penetrate the earth to a considerable depth.

Remarkable Meteor. May 23, 1823.—At ten o'clock at night a luminous meteor was observed at Kiel, in Denmark. It was seen almost at the same time at Copenhagen, which is 60 miles from Kiel. This will give some idea of its size and velocity, which was apparently not very great. At Kiel it seemed to take a direction from S.E. to N.E. and to have an elevation of 30 degrees. It was visible for 10 seconds. As it disappeared, it threw out a volume of sparks, and left a luminous track in the sky.

AURORA BOREALIS.—Light streaming in the night from the North. It is said that in the Shetland Isles they are the constant attendants of clear evenings, and are a great relief to the gloom of the long winter nights; they generally appear near the horizon at twilight of a dun colour, approaching to yellow, continuing so for the space of several hours without any perceptible motion; then they form streams of stronger light, having the appearance of columns altering slowly into 10,000 different shapes, with colours varying from all tints of yellow to a russet.

Dr. Thienemann, who passed the winter of 1820-21 in Iceland, made numerous observations on the Aurora Borealis, of which the following are general results:

1st, The Aurora Borealis has its place in the lightest and highest clouds of our atmosphere.

2d, It does not occur in the winter and night time only; but at all times, being visible, however, only in the absence of the sun's rays.

3d, It has no determinate relation with the earth.

4th, No sound occasioned by it has ever been heard.

5th, The form in Iceland is generally that of an arc, extending from N.E. to W.S.W.

6th, The motions are variable, but always occurring within the limits of the clouds containing the meteor.

AURORA AUSTRALES—Or Southern Lights, were observed bv Mr. Foster on 16th February, 1773, in S. lat. 58 deg. This beautiful phenomenon, was seen again for several succeeding nights. Its form was that of columns of clear white lights shooting upward from the horizon to the eastward, almost to the zenith, and gradually spreading on the whole southern sky; these columns were sometimes bent sideways at their upper extremities, and though they were in most respects similar to the Aurora Borealis, yet they differed from them in being always of a whitish colour. The sky was generally clear when the Aurora Australes appeared, with the air sharp and cold, the thermometer standing at the freezing point.

LIGHT.—Some philosophers consider light to be particles of extreme minuteness, emitted in succession by luminous bodies, moving in straight lines at the rate of about 200,000 miles in a second.

ZODIACAL LIGHT.—This is a brightness observed at times in the Zodiac, resembling that of the galaxy, or milky way. It appears at certain seasons, viz. towards the end of winter and spring, after sunset, or before his rising in autumn, and at the beginning of winter, resembling the form of a pyramid lying lengthways, its base being placed obliquely with respect to the horizon. This phenomena was first named and described by the elder Cassini in 1683.

The zodiacal light, or solar atmosphere, is a subtile fluid, made luminous by the rays of the sun, but in a greater degree, and to a greater extent about his equator than in any other part.

M. Humboldt observed the zodiacal light at Caraccas, in Colombia, on 18th January, after 7 h. p. m. The point of the pyramid was at the height of 53°. The light totally disappeared at 9 h. 35 m. apparent time, about 3 h. 50 m. after sunset, without any diminution in the serenity of the sky. On the 15th of February it disappeared 2 h. 50 m. after sunset, and the altitude of the pyramid was 50° in both instances; the intensity of the zodiacal light changed in a very sensible manner, at intervals of two or three minutes; sometimes it was very faint, at others it surpassed the brilliancy of the milky way in Sagittarius. The changes took place in the whole pyramid nearly, but especially toward the interior, at some distance from the edges.

TWILIGHT, sometimes called Crepusculum, is that faint light perceptible before sunrise and after sunset. It is occasioned by the sun's rays being refracted through the infinitely small particles of the atmosphere; twilight commences at first dawn or appearance of what is termed morning to the rising of the sun. Between the setting of the sun, and the expiration of day, twilight takes place again, this is called evening twilight.

MOONLIGHT.—With respect to this light, it may not be improper to mention the particularly useful effects of moonlight in assisting certain important natural phenomena. The crystalization of water, for instance, which takes place, and is so very prevalent early in the spring, is of invaluable service—first, in assisting the operations of agriculture—secondly, by rendering the surface of the earth more mellow and better susceptible of the power of the manure; all which circumstances are greatly assisted, and probably chiefly effected, by the intervention of moonlight. It is well known, that, in certain cases, water wlll sink to the temperature of 22° before freezing or taking the form of crystals; indeed this it will invariably do in the absence of mechanical agitation, or in the absence of light. It is a fact, though not generally attended to, that during that period of the year already alluded to, and at other periods, before the moon rises, on a still clear night, when the atmosphere is at a lower temperature than 32°, the water remains in a liquid state, but on the moon's rising, and diffusing her light, the water freezes and performs the salutary offices required of it, without subjecting us to the severity of a low temperature.

CLOUDS.—These are a collection of vapours in the air. Against much rain the clouds increase very fast both in size and number; however, more especially previous to thunder. When the clouds are shaped like fleeces, but dense in the middle, and bright toward the edges, with the sky bright, they are signs of frost, which is often attended with hail, snow, or rain. When clouds appear high in the air, having the appearance of locks of wool, they portend wind, and probably rain. When a general cloudiness obscures the sky, interspersed with dark fragments of clouds passing underneath, it is a sure sign of rain, and that for a continuance. Two currents of clouds in winter always portend rain, but in summer they denote thunder.

WIND.—Wind is a current of air moving a portion of the atmosphere from the place it occupied to any other, with an impetus sensible to us—not improperly called by the ancients a swift course of air, a flowing effusion or stream of air, &c. Should the wind veer about, expect much rain. If it follows the course of the sun in changing, it will bring fair weather. But if it does not follow the course of the sun, expect unsettled weather. Whistling or howling of the wind is a sure sign of rain. In all maritime countries, situated between the tropics, the wind blows daily from the sea a certain number of hours, and during a certain number of hours the wind blows from the land. Such winds are called land and sea breezes. The sea breeze generally sets in between the hours of two and eleven in the forenoon, and blows till between six and seven in the evening; from seven to eight in the evening the land breeze begins, and continues till about ten the next day.

THE CAUSE OF WINDS. As the air is rarified or made to expand by heat, and the entrance of wind is a necessary consequence of it, for when any part or parts of the atmosphere becomes heated by the sun, or otherwise, expansion immediately takes place, which will affect the adjacent parts of the air to an indefinite extent, so that by various portions of heat being diffused into them there will arise various winds. When the air is much heated it will ascend to the upper part of the atmosphere, and the adjacent air will rush in to supply its place, and therefore there will be a stream or current of air from all parts towards the place where the heat is. And hence we see the reason why the air rushes with such force into a glass-house, or towards any place where a great fire is made, and also why smoke is carried up a chimney, and why the air rushes in at the key-hole of the door, or any small chink where there is a fire in the room. Therefore we may take it in general, that the air will press towards that part of the world where it is most heated.

From ten years average of the register kept by order of the Royal Society, it appears that the winds blow in the following directions at London:——S. W. 112 days—N.E. 58—N.W. 50—W. 53—S.E. 32—E. 26—S. 18—N. 16.——365 days.

The velocity of the wind varies from the most gentle breeze to the West Indian hurricane, as follows:

Light Airs, from 1 to 3 miles per hour, 1.47 to 4.40 feet per second—Breeze, from 4 to 5, 5.87 to 7.33—Brisk Gale, from 10 to 15, 14.67 to 22.—Fresh Gale, from 20 to 25, 29.34 to 36.67—Strong Gale, from 30 to 35, 44.01 to 51,34—Hard Gale, from 40 to 45, 58.68 to 66.01—Storm, from 50 to 60, 73.35 to 88.02—Hurricane, from 80 to 100, 117.36 to 146.70.

ANEMOMETER.—An instrument for measuring the strength or velocity of the wind. See an account of a curious one in the Reg. of Arts and Sciences, Vol. I, page 280.

LIGHTNING.—Is a large bright flame, shooting swiftly through the atmosphere, of momentary or very short duration, and commonly attended with thunder. It is now universally allowed that lightning is an electric phenomenon, caused by ignition and explosion.

THUNDER.—Is that awful and interrupted vibration in the air, excited by a sudden explosion of electric matter. Thunder is variously accounted for. However, of all the dangers to which the seamen's lives are incident, there are none so terrifically sublime when viewed from a certain distance, or so dreadfully appalling to the mind, as that combination of meteorological and electrical phenomenon, so well known by the appellation of thunder.

In the dark midnight of an autumnal cruise, as repeated through a series of years upon the southern shores of France, for political purposes, during the unremitted perseverance of the British fleet, the above various sensations were often experienced by thousands. In the midst of a numerous fleet of Britain's hardy tars, exposed on such nights to sudden squalls and baffling shifts of wind, when large drops of rain fell, few but heavy, on deck; when the fleet at times became almost unmanageable, now rolling in the trough, or borne up by the waves of the agitated sea; when distant thunder was dreadful from the land, and the vivid lightning disclosed at every flash the scattering fleet; in circumstances such as these, the orderly and determined resolution of the British seamen is beautifully exemplified;

whose precarious situation not only claims but deserves, in the strongest manner, all that philosophers, men of science, and men of opulence, can do for their benefit.

Causes of Thunder and Lightning.—When sufficient quantities of nitrous and sulphurous vapours are admitted into the air, they frequently take fire, effecting the phenomena called Lightning and Thunder; the former sometimes appears darting right forward, sometimes obliquely, at other times taking a zig-zag course. The latter is that loud and interrupted sound heard after the explosion that had taken place from ignition.

THUNDERBOLT.—When that wonderful appearance in nature called lightning with a violence peculiar to itself, breaks, shatters, or destroys, the uninformed, in order to fit it well for such important work, suppose it to be a hard body; but experience teaches us that we need not have recourse to a hard solid body to account for the effect so commonly attributed to the thunderbolt, which a trial with pulvis fulminans, or gunpowder, will more fully elucidate.

EARTHQUAKE.—Tremour or Convulsion of the Earth. Shock of a great earthquake was felt in the peninsula of India, and at Columbo in Ceylon, on 9th Feb. 1823. It was also felt on board the Orpheus, in lat. 1 North, and long. 80 East. The boxes in the cabins were put in motion, and the first shock lasted nearly one minute. They experienced three shocks in all; the first about 1 p. m.; the second about 5 minutes past 2; and the last and weakest about 5 p. m.—Ceylon Gazette, Feb. 22.

Calcutta, August 16, 1822.

Earthquake felt at Sea.—The Hon. East India Company's ship Winchelsea, on the 10th Feb. 1823, at 1h. 10 p. m. in E. long. 85 deg. 33 min. and N. lat. 52, experienced a shock similar to that of an earthquake. A tremulous motion of the vessel, as if it were passing over a coral rock, alarmed all on board, and this was accompanied with a loud rumbling noise, both of which continued two or three minutes. As the ship was going only 2 knots an hour, the Captain saw there was no shoal, and considered the ship as out of soundings. There was no commotion on the sea, and the vessel was some hundred miles from land. This phenomenon has been ascribed to some volcanic eruption in one of the islands to the east of the Bay of Bengal.——Parsons in the Med. Repository, Vol. 20, page 175.

On the 9th Nov. 1822, Valparaiso (which, from being a miserable village, had, by the blessings of commerce and civilization, increased within a few years to 17,000 inhabitants) was laid in ruins by an earthquake. The shock lasted four minutes, and all the churches and about two thirds of the city were destroyed. About 200 of the inhabitants perished, and a great quantity of merchandize was lost. The shock was felt (but did no injury) at Santiago.

The whole of South America is subject to earthquakes.

For an account of an earthquake in Chili, in Nov. 1822, see Royal Quart. Jour. No. 33.

For an account of a dreadful earthquake in Persia, in June 1824, See Bombay Gazette, Sept. 8, 1824.

It is said that a haziness in the atmosphere, and a particular kind of obscurity about the sun, were the phenomena remarked previous to the three earthquakes at Selva Piana, Grand Duchy of Tuscany, about 13th August 1824.

Brussels, Sept. 1, 1824.—On 18th August, in the afternoon, a phenomenon, very rare in this country, was observed at Harderwyck, in Guilderland. A noise like that of several loaded waggons running rapidly was heard in a S. W. direction. In some houses the doors suddenly flew open, in others the noise was so loud that the people thought the roof was coming down. In a plantation in the town, some soldiers asleep on the grass were awakened by the subterraneous noise, and feeling the ground tremble under them were frightened and went away. It seems, therefore, that the noise which the inhabitants heard was under ground, and that there was a shock of an earthquake.

Meteor and Earthquake.—It is said that a traveller, who happened to be during the nights of the 11th and 12th of August, 1824, upon the Alps, saw a globe of fire which illuminated the atmosphere for the space of three minutes; and about the same time the shocks of an earthquake were felt in several parts of Italy.

Earthquake at Kutch, Edin. Jour. No. 5, p. 120, and for Storms see page 198.

Earthquake and rain at Java, see Asiatic Journal, Vol. 9, page 409.

ATMOSPHERICAL ELECTRICITY.—There are four sources of atmospherical electricity:

1st, Friction, 3d, Heat and Cold,
2d, Evaporation, 4th, Expansion and Contraction,

Not to mention the electricity involved by the melting and freezing solutions of various bodies in contact with air.

ELECTRICITY PRODUCED BY CONGELLATION OF WATER.—"When water is frozen rapidly in a Leyden jar, the outside coating not being insulated, the jar receives a feeble electrical change, the inside being positive, the outside negative. If this ice be rapidly thawed an inverse result is obtained, the interior becomes negative, and the outside positive."—Grothus.

ON THE NATURE OF THE ATMOSPHERE OF SEAS.—In a curious paper on this subject, published by M. Vogel of Munich, in the Journal de Pharmacie. No. 2, for Nov. 1823, pages 501, 506, this learned chemist has given the following results:

1. That the air of the English channel, between Dieppe and Havre (on the coast of France), contains muriates.
2. That the air of the English channel, as well as the air of the Baltic, contains a less quantity of carbonic acid than the air of the European Continent.
3. That the muriates do not disengage their acid at a temperature capable of bringing them to ebullition, but that they are partly volatilised with the vapours of the water.
4. That there is no particular colouring principle in sea air, as M. Hermbstaedt of Berlin thought; and that the red colour produced by nitrate of silver with the aid of the sun, is due rather to the muriates.
5. That all water whatever, which contains traces of muriate, possesses the property of acquiring a wine red colour, with nitrate of silver, when exposed to the sun.

OIL BAROMETER.—This instrument is taken notice of at page 11. It should always be kept in an upright position, and whether intended for use on ship-board, or on shore, it would be desirable to have it fixed to the wainscot or wall, &c. to guard as much as possible against accidents. When fixed, turn the milled head screw at top, which will raise the cork for the admission of air. Next, after a little time has elapsed, observe the division at which the mercury in the thermometer stands, then slide the barometer scale up or down until the point comes to the same number or division as indicated by the thermometer. Lastly, observe the barometer scale, and notice the elevation of the oil in the same manner as it is customary to observe the height of the mercury in the barometer tube.

N. B.—It generally ranges higher than the mercurial barometer, but nevertheless is a valuable companion to it.

MAXIMS ON THE WEATHER.—A moist autumn, with a mild winter, is generally followed by a cold and dry spring, which greatly retards vegetation. If the summer be remarkably rainy, it is probable the ensuing winter will be severe; for the unusual evaporation will have carried off the heat of the earth. Wet summers are generally attended with an unusual quantity of seed in the white-thorn and dog-rose bushes; hence the unusual forwardness and fruitful appearance of these shrubs is a sign of a severe winter. The appearance of crows and birds of passage early in autumn announce a very severe winter; for it is a sign that this season of the year has already begun in the northern countries. When it rains plentifully in May, it will probably rain but little in September, and *vice versa*. When the wind is S. W. during summer or autumn, and the temperature of the air unusually cold to the sensation for the season, and the thermometer is found low, much rain may be expected. Violent temperatures, as storms or heavy rains, produce a sort of crisis in the atmosphere which effect a constant temperature, good or bad, for some months. A very rainy winter predicts a sterile year. A severely cold autumn announces a windy winter.

It may be needful to observe, that the winter quarter begins Dec. 21—the spring, March 20—the summer, June 21—the autumn, Sept. 23.

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